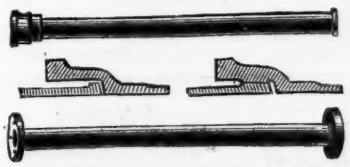
# THE JOURNAL OF GAS LIGHTING
## WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXXII. No. 1846.] LONDON, SEPTEMBER 27, 1898. [50TH YEAR. PRICE 6d.



**GAS AND WATER PIPES**

1½ to 12 IN. BORE.



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**Bonlea Foundry,**

SOUTH STOCKTON-ON-TEES.

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GLASGOW. BERLIN. STOCKHOLM.

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THE ONLY MAKERS OF

**PATENT ANTIMONY PAINT,**

**Parker's Imperial Black Varnish,**

*Oxide Paints, Oils, and General Stores, for Gas and Water Works.*

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*Prices and Analysis of all the Scotch Cannels on Application.*

**Wrought-Iron**

**And Fittings and Accessories.**

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BRASS GAS-FITTINGS, GAS-VALVES, STEAM & WATER VALVES, TOOLS, &c., AND OF WARNER'S PATENT MARKET GAS STAND-PIPE.

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**BIGGS, WALL, & CO.,**

GAS ENGINEERS,

*49, FANN STREET,*

ALDERSGATE, LONDON, E.C.

The "TIMES," REGISTERED.

*Twentieth Century Street Lighting.*

**ELECTRICITY**

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BY

CHIMNEYLESS

New Incandescent Burner,

FITTED IN OUR

**"DEMAND" LANTERN,**

*WHICH IS ABSOLUTELY UNIQUE.*

**WRITE FOR THIS SEASON'S LIST.**

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12,000 PUMPS IN STOCK AND PROGRESS.

TRADE MARK.

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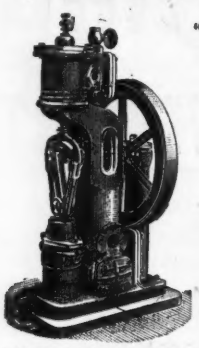

Fig. 705. "SINGLE RAM" STEAM-PUMP.

Fig. 598. "CORNISH" STEAM-PUMP FOR BOILER FEEDING, &c.

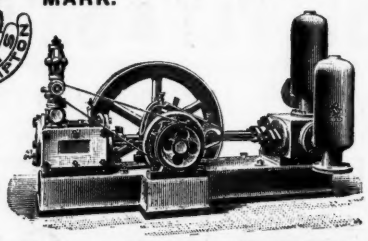

Fig. 685. "RELIABLE" STEAM-PUMP FOR TAR AND THICK FLUIDS.

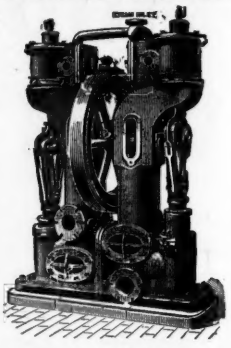

Fig. 712 "DOUBLE-RAM" STEAM-PUMP.

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Has introduced INCLINED RETORTS during the last 9 years into the following and other Gas-Works.

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| NEWCASTLE-UNDER-LYNE. | BURNLEY. | HUDDERSFIELD. | MIDDLETON. |
| GATESHEAD. | MANCHESTER. | BATLEY. | CAMBRIDGE. |

## GRAND SUCCESS of GRAHAM'S FURNACE at LEEDS.

Works: BLACK BULL STREET, LEEDS.

THE NEW IMPROVED

# PATENT JENA INCANDESCENT GAS BULB.

WITH LATERAL AIR-SUPPLY HOLES, INCREASING THE LIGHT BY 50 PER CENT.

SUITABLE FOR WELSBACH "C" INCANDESCENT GAS-BURNERS.

PROTECTED BY TWO PATENTS.

This Bulb is an improvement on all existing Glasses for Incandescent Burners, and can be used with the fancy Screens shown on pp. 54 & 55 of our Supplementary Catalogue No. 67, whereby highly Artistic and Decorative Effects are obtained.

The Advantages may be briefly stated as follows:—

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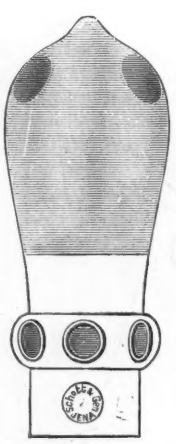
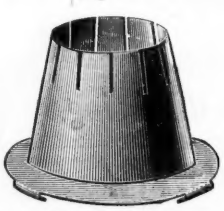
Mantles Screened and Protected from Draught and Dust.

Equal in Appearance to Electric Light.

HIGHER CANDLE POWER THAN ORDINARY ELECTRIC INCANDESCENT LAMPS.

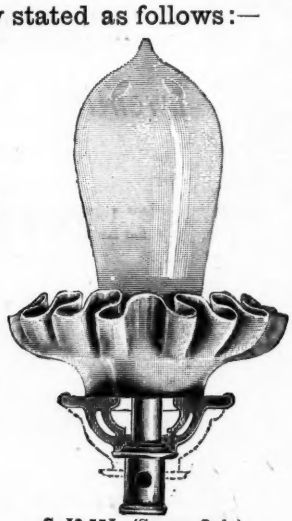


G 1689. Half Obscured.



G 1691. Brass, 2s. 0d. per doz. Air-Diverting Cone, to be placed inside Burner.

FURTHER PARTICULARS ON APPLICATION.



G 43,554 (Screen Only).

Jena Glass will not Break with Heat.

Bulb kept Cool, owing to large volume of Air flowing between Mantle and Glass.

BULB BEING COVERED AT TOP ACTS AS A PERFECT SMOKE CONSUMER

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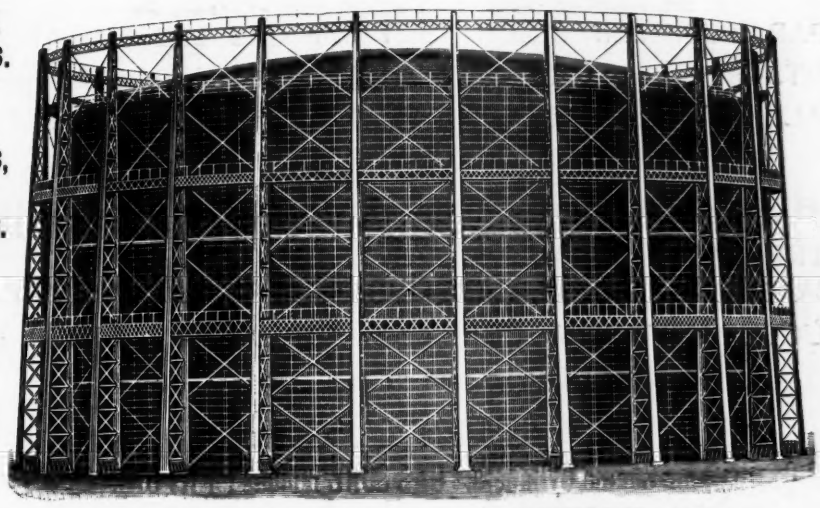

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ATLAS METER WORKS, OLDHAM.

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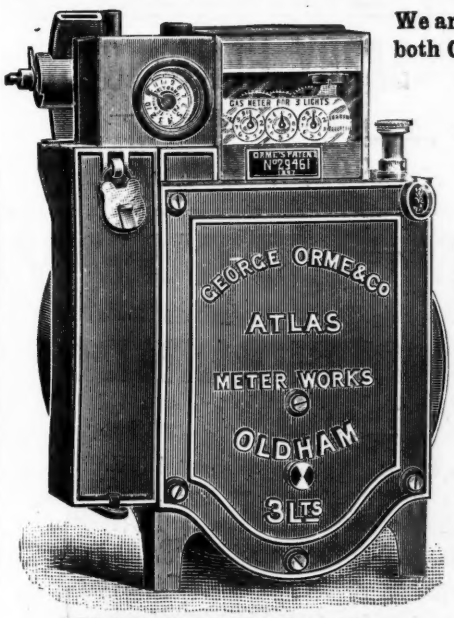


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We are now supplying our Wet Coin Meters in Cast-Iron and Tin-Plate Cases, both Ordinary and Compensating; also Dry Coin Meters in Tin-Plate Cases.

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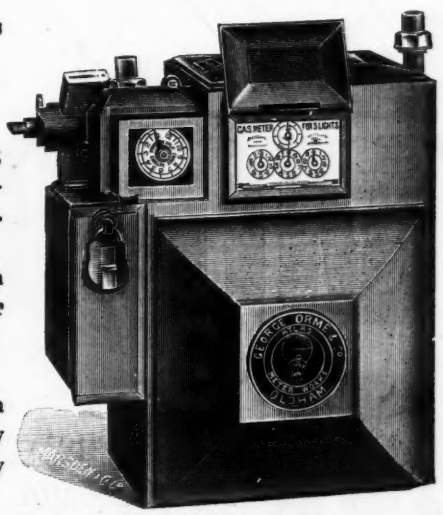
The Mechanism is very simple; and there are no springs or complicated parts to get out of order.

We supply them to work with **1d., 1s., or any other Coin desired.**

The Selling Price of Gas can be changed *in Situ*, and any number of feet delivered, as may be required.



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RETORTS and FITTINGS, MOUTHPIECES with Self-Sealing Lids.

Improved COAL and COKE HANDLING PLANT, CONVEYORS, and ELEVATORS,

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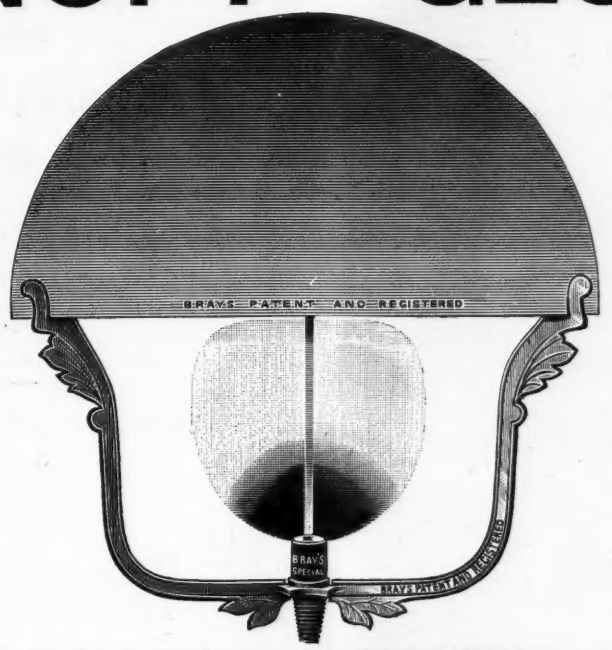
They do not dirty Ceilings or get Black themselves, and preserve Decorations from Smoke.

Save in White-Washing and Decorations alone more than will pay the Gas Bill, and keep the House bright and clean.

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In average use they give more light than Incandescent Burners, at less first cost, and about one twentieth the cost of renewals.

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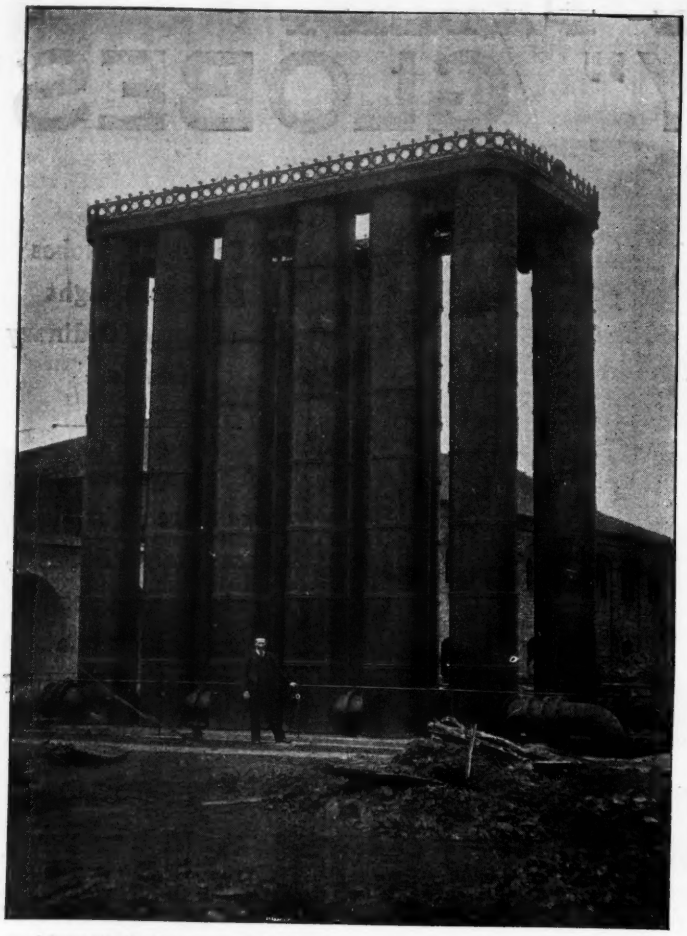

A Set of Twelve Condensers, 3 ft. 6 in. diameter by 30 ft. high. *From a Photograph.*

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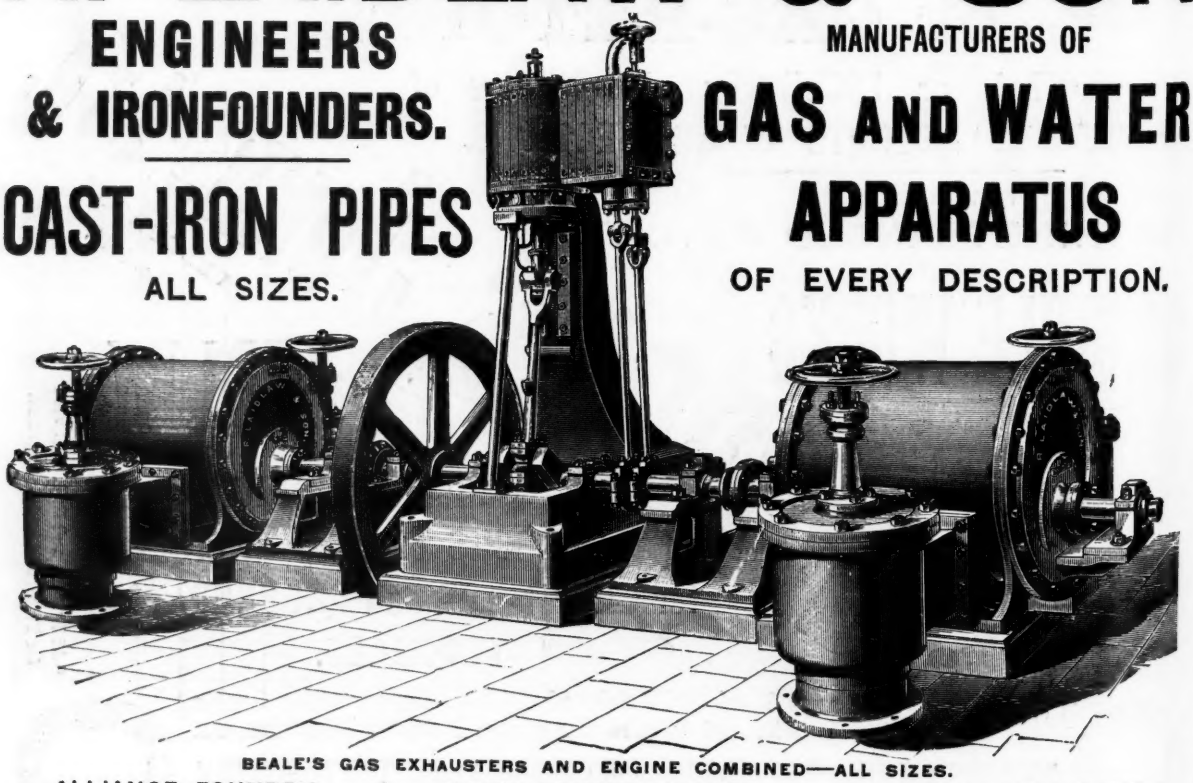

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ALLIANCE FOUNDRY, GLASGOW. | SIMON SQUARE WORKS, EDINBURGH. | 6, LITTLE BUSH LANE, LONDON, E.C.

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## MANCHESTER;

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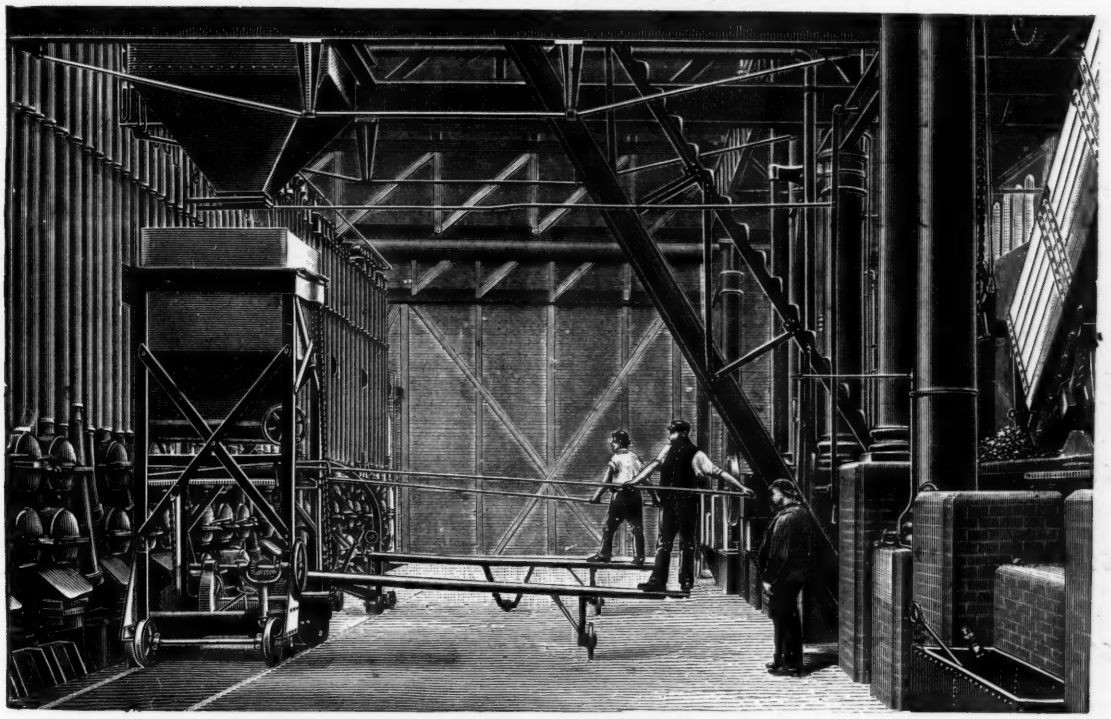
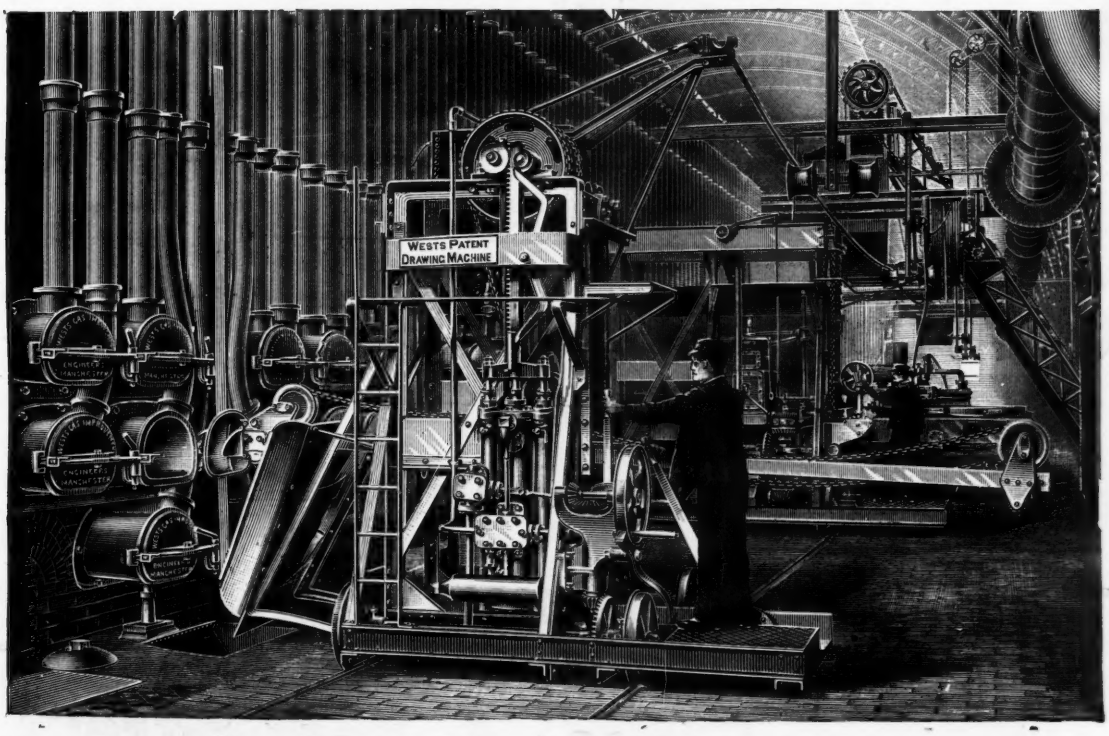


West's Manual Charging and Drawing Machines.

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**PROPORTIONATE REDUCTION OF PRICES IN ALL PATTERNS.**

## Great Reduction in Chimneys, Globes, &c.

**New Price List on application to**

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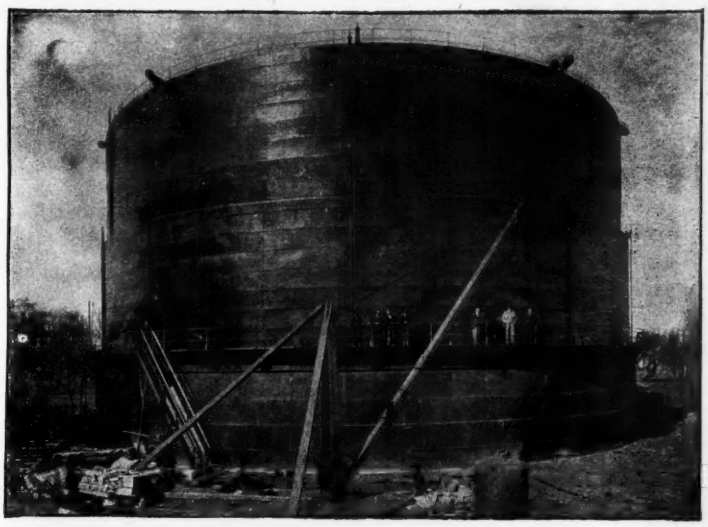

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*Examples of Holders without External Framing in Steel Tanks, to be seen at—*

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| PERTH (Australia) | 75 ft. by 30 ft., | 2 ,, |
| NEWBURN | 45 ft. by 17½ ft., | 2 ,, |
| MIDDLESBROUGH | 184 ft. by 30 ft., | 3 ,, |

*In Brick Tanks at—*

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| BATHURST | 82 ft. by 18 ft., | 2 ,, |
| SLIGO | 50 ft. by 18 ft., | 3 ,, |
| MILAN | 116 ft. by 23 ft., | 2 ,, |
| ATHENS | 65 ft. by 21 ft., | 2 ,, |
| BARCELONA | 99 ft. by 26 ft., | 2 ,, |
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| FALMOUTH | 50 ft. by 26 ft., | 2 ,, |
| TRURO | 62 ft. by 21 ft., | 2 ,, |
| BIRMINGHAM | 80 ft. by 20 ft., | 1 ,, |
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**And numerous other single and 2-lift Holders.**

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# PREPAYMENT GAS-METER

FOR PENCE, SHILLINGS, OR ANY COINAGE.

### THE ADVANTAGES OF THIS SYSTEM ARE:

1. Simplicity of Mechanism.
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3. Impossibility of being tampered with.
4. Unaffected by irregularities in shape or thickness of the penny.
5. Can be fixed to any ordinary Wet or Dry Meter.
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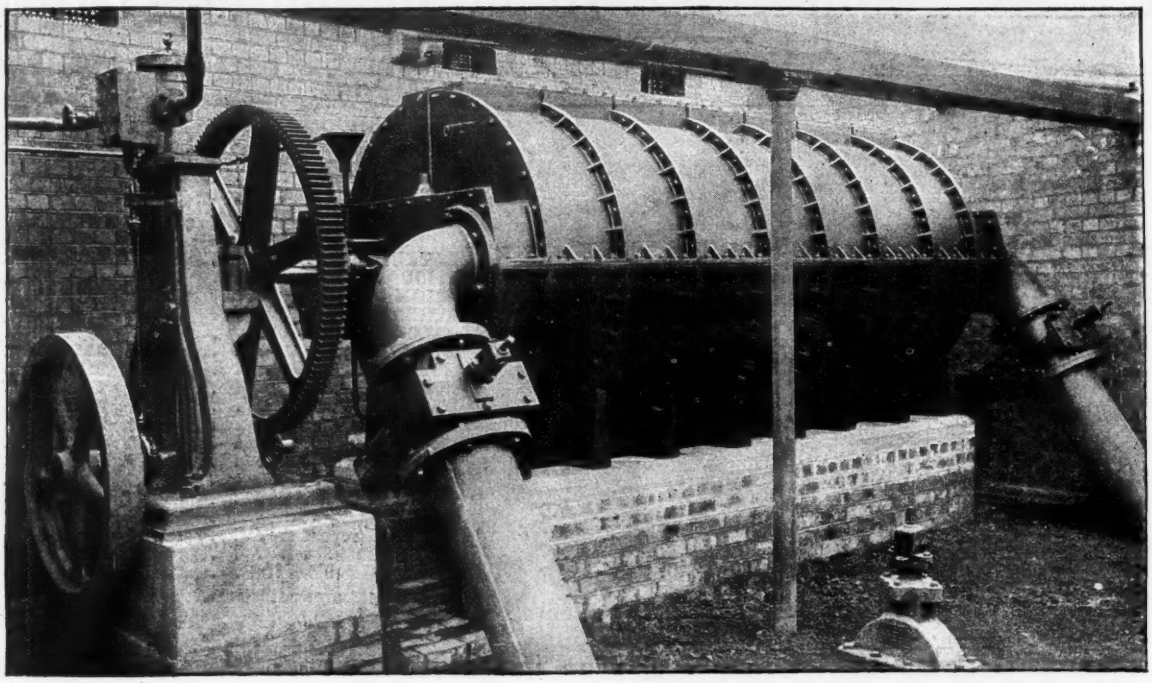

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**Extracts all Ammonia and a large proportion of Sulphuretted Hydrogen and Carbonic Acid.**

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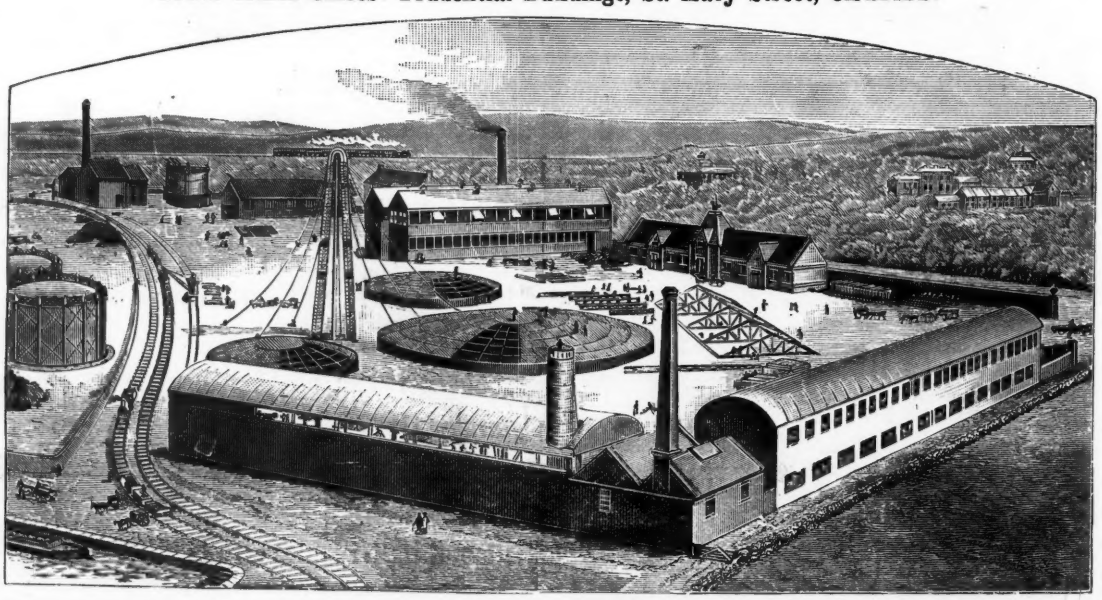

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SINCE 1893

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FOR THE FOLLOWING UNDERTAKINGS:—

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| Belfast | 1,700,000 | Guildford | 350,000 |
| Belfast (Second Contract) | 4,500,000 | Syracuse, N.Y. | 850,000 |
| Brussels | 700,000 | Brentford | 1,200,000 |
| Brussels (Second Contract) | 700,000 | Commercial Gas Co. | 850,000 |
| Liverpool | 3,500,000 | Commercial Gas Co. (Second Contract) | 850,000 |
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| Tottenham (Second Contract) | 750,000 | Middlesbrough | 1,250,000 |
| Santiago | 400,000 | Croydon | 1,250,000 |
| Swansea | 750,000 | L. & N.W. Railway, Crewe | 700,000 |
| Manchester | 3,000,000 | Taunton | 225,000 |
| Brighton | 1,750,000 | Lawrence, Mass. | 400,000 |
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| New York | 1,200,000 | Dorking | 125,000 |
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| Coventry (Second Contract) | 600,000 | Perth, W.A. | 125,000 |
| Bordentown, N.J. | 125,000 | Bremen | 550,000 |
| Winchester | 200,000 | Maidenhead | 225,000 |
| Shanghai | 225,000 | Epsom | 225,000 |
| Stockport | 500,000 | North Middlesex | 150,000 |
| Norwich | 1,000,000 | Wandsworth and Putney | 1,800,000 |
| Holyoke, Mass. | 600,000 | Aarhus | 800,000 |
| St. Joseph, Mo. | 750,000 | Falmouth | 150,000 |
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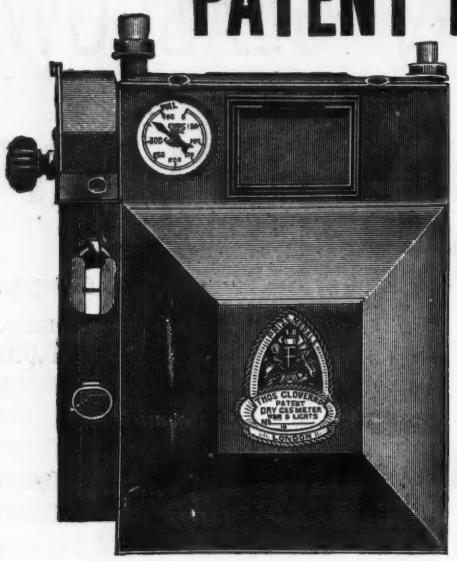

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## EDITORIAL NOTES.

### Threatened Trouble in the Yorkshire Coalfield.

IT is with a feeling more than slightly akin to despair that one is forced to recognize the existence of yet another labour "crisis" in the coal-mining industry. This time it is the English coalfield over which the Miners' Federation holds sway that threatens trouble, unless the divergent views of employers and employed can be reconciled; and the constant outbreaking of discontent among coal miners, now here, now there, is as wearisome to record as it is distressing to contemplate. No sooner has the South Wales strike ended with the utter discomfiture of the men, than Yorkshire in its turn appears anxious to stop producing coal. Last week the men's officials sent round a circular, which began with the ominous words: "We are now face "to face with a great crisis in the history of the coal trade." Once more! The occasion is soon described. The men belonging to the Yorkshire Miners' Association took it into their heads some time ago that they ought to have a 10 per cent. advance of wages. In the "JOURNAL" for July 12 we mentioned the holding of a conference respecting this demand, between the Associated Employers and the men's Committee, which resulted in an agreement regarded at the time as mutually satisfactory. Unfortunately, however, the men afterwards repudiated the action of their representatives on this occasion; and another meeting had to be called early in the present month, at which the men's "leaders" were fain to confess that their constituents had broken away, and stood firmly by the original demand. The meeting was of a very amicable character, considering all the circumstances. The employers were quite willing to treat the question of higher wages simply as a matter of business, to be settled upon a financial basis by a Conciliation Board. There was no suggestion at all of difficulty about control, or a minimum wage, or any other point of principle, to embitter the situation. It was solely a disagreement as to the rate of coal miners' wages which the circumstances of the trade permitted to be paid.

The employers are organized, and so are the men; and if ever organization might be held competent to shorten a controversy of this nature, this should be the occasion. Yet there is said to be a "great crisis." Why? Because the members of the Trade Unions will not trust their paid leaders to decide for them in a question of wages. The officials, to do them justice, are standing by their July agreement with the employers. They declare that in their judgment the terms then accepted by them were the best that could be had; and they conclude their recent circular in the following words, which are not without pathos in the circumstances: "We have no desire to "thrust anything down the throats of our members; but "if our advice is worth anything, we trust on this occasion "it will be taken." The circular also reminds those to whom it is addressed that, if they want anything else, it can only be had "by fighting for it on the old lines, and "not only for this, but for all other alterations in wages." In plain English, the miners are told that the method of peaceable negotiation between masters and men on the subject of rates of wages is at stake. Of course, the men can strike if they will; but if they proceed to this extreme against the advice of their own leaders, what becomes of the vaunted value of "strong Unions" as a means for the peaceful settlement of all trade disputes not involving matters of principle?

The emergency is a real one. The officials who are thus staking the future of the Yorkshire Miners' Association and the Miners' Federation of Great Britain, for any other use than that of a fighting-machine, upon the issue of their present appeal to the members, are Messrs. Pickard, Cowey, and their principal associates. History shows that these are not the men to shun a fight when they see a chance of winning, or cannot find any other way out of a deadlock. If, despite their advice, the Yorkshire miners elect for a strike, such a revolt will be a greater blow to the cause of Trade Unionism than the heaviest defeat in the ordinary course; for it will remove the operation of striking from the category of rational actions, and relegate it to that of the blind play of natural forces. The South Wales strike was something like this; but there the men had no organization, nor any leaders worthy of the name. The Yorkshire miners have everything in this way that the most ardent Trade Unionist

could desire; and if they now throw all these supposed advantages to the winds, the friends of Trade Unionism will be put to it to say what is the real good of this kind of organization.

Just before going to press, we learn that the question in dispute will be answered to-morrow. On Saturday, a special conference of the Lancashire and Cheshire Miners' Association was held in Manchester, to receive the result of the ballot on the wages question. As in the case of the Yorkshire contingent of the Federation, the men had three courses submitted to their vote—the coalowners' proposal of July for a 2½ per cent. advance from October 1; the second proposal by the coalowners to refer the question of wages to arbitration; and the handing in of 14 days' notices to demand a 10 per cent. advance. Mr. S. Woods presided, and 92 delegates were in attendance, representing nearly all the collieries in the two counties. The returns presented showed a large majority voting in favour of demanding the 10 per cent. advance. The Yorkshiremen were to meet yesterday to give their final decision on their leaders' letter. The Midland men have already decided to accept the employers' terms. Hence Yorkshire holds the balance between peace or war. To-morrow the coalowners and miners' representatives meet in London to receive the final report of the latter on the situation. At the present moment, it is uncertain what the issue will be, supposing the men to insist upon the 10 per cent. advance. A sinister rumour published in yesterday's "Times" introduces a disturbing element into the calculation of probabilities. It is to the effect that the application for a 10 per cent. advance "was really made at the "suggestion of some of the employers, with the view of "assisting the men in South Wales and Monmouthshire "to do away with the sliding-scale, and so prevent the "keen competition of the two districts." If this statement is true, the employers might as well drop the farce of union, and let the men walk over their scattered remains. In July the associated coalowners took up a very determined attitude; asserting that the condition of trade in England and Scotland did not warrant any such advance, and giving statistics in support of this contention.

Whatever considerations are taken into account, however, the emergency is undoubtedly serious. It is possible to raise an ulterior point, with regard to the expediency of the method of determining questions of this kind by balloting the men. On the face of it, a ballot seems the most direct and reliable way of ascertaining the sentiment of any body of men; but there is more in a proceeding of this kind than meets the eye. However this may be, the professional leaders of the Miners' Federation appear to be bound on the present occasion to give effect to the members' votes; and there is only too much reason to fear that the majority will be against a peaceful settlement of the difficulty. Even so, the employers have the opportunity of saying another word. It was in July that they declared the state of trade unpropitious for an advance that would satisfy the men; and their refusal was ostensibly based on statistics stopping short at the quarter ending with March. A good deal has happened since then. Coal prices have gone up a little, though not so much as the men expected would be the case. The market is not in a strong condition; but the men might get a little more money without anybody being hurt in consequence. Gas undertakings, at any rate, have had to pay dearer for their supplies—a circumstance which the coalowners cannot venture to deny. On the whole, therefore, grave as the situation is, we cannot think it means a general strike over the Federation area just now.

### The Workmen's Compensation Act in the Courts.

THE first of the crop of litigation under the Workmen's Compensation Act has been gathered; and it is of the utmost importance that the course of every such case should be marked. One never knows how an Act will work until it is tested in Court with regard to particular cases. Only too often months of debate in Parliament leave an Act so incompletely framed, or so badly worded, that the Courts have the greatest difficulty in divining what its language means. In the two instances of proceedings under the Act that have come under our notice already, there are indications that the new statute is not so clear as could be desired. Yet in the main it came out well from the test; substantial justice being done in both instances. At the Liverpool County Court, the widow of a brakesman who had lost his life in the service of the London and North-Western Railway Company brought an action against the Company for compensation. The amount had been agreed upon before the case came into Court; the plaintiff consenting to accept £200 on behalf of herself and her five children. There were no lawyers engaged on either side; and for this reason possibly the learned Judge straightway fell into a legal error himself. "His Honour explained that under the Act the plaintiff "would have to take out letters of administration, and "adjourned the case for the purpose." There is nothing about this in the Act, so that the Judge must have decided in this sense out of respect to general principles. Mr. John Aird, however, fortunately happens to be in a position to supply particular information on the point. From his place in the House of Commons on June 9, Mr. Aird asked the Chancellor of the Exchequer whether compensation awarded to the dependents of fatally-injured workmen would be liable to estate duty, and necessitate probate or letters of administration being taken out. The reply was that the Board of Inland Revenue did not regard such money as property passing on the death for the purposes of estate duty. "So far as they are concerned, it will not "be necessary that probate or letters of administration "should be taken out where the deceased has left no other "property." Every publicity should be given to this statement. In the case in point, the Company acted as best they could to save the claimant trouble and expense. The claim was for an amount equal to the deceased's earnings for three years preceding the death; and £15 for each child, to be invested in the Post Office Savings Bank. The balance was to be handed to the widow. The claim was fully met by the Railway Company, who also allowed the widow £10 as living expenses immediately after the accident. Under the old insurance fund of the Company, the widow would only have been entitled to £100. The Act has therefore been a distinct boon to this poor woman and her family.

In the other case, which was brought in the Perth Sheriff Court, Sheriff Grahame had to determine a question which it has been foreseen would often give trouble. The claimant was a planing-machine minder; and he injured his hand while planing a mallet for an apprentice in the same employ. The defence of the employers was that the injury was not due to an "accident arising out of, and in "the course of, the employment," as specified in the Act, inasmuch as the work was not done for the employer, but at the request of the apprentice. Not only was it outside the man's employment, but there was evidence that it was done against the shop rules, which forbade the making of tools during working hours. Consequently, the Sheriff could do no other than he did, which was to give judgment for the defendants. He said, with reason, that the Act is altogether in favour of the employee, and increases very largely the responsibility of the employer. The fact of employment is the foundation of liability; and this has to be established before a claim under the Act can be made out. Mr. Willis, in his little book upon the Act, points out this necessity; remarking that the extent of the operation of the Act will be greatly affected by the construction which the Courts put on the words "arising "out of, and in the course of, the employment." The same authority lays stress upon the use of the word "and" in this section; observing that it has a limiting effect, which is doubtless true. Once more, therefore, we have to direct our readers' attention to the literal wording of the Act, if they wish to know what it means. The putting of imaginary cases is to be deprecated, because the facts seldom exactly fulfil expectations of what may happen. It is to be observed that in the case in point the sufferer might perhaps have been said to have put himself outside the Act by "serious and wilful misconduct" in breaking a shop rule; but it is doubtful if a Court would have allowed such a defence. As it was, the defence was perfect; and it accordingly prevailed.

### Municipal Trading at a Profit.

THE case for municipal trading at a profit was argued before the British Association by Mr. G. Pearson and Mr. E. Cannan. The former is a Bristol town councillor; and he defended his views by referring to local circumstances in a way that enabled us to deal with the point in our "Electric Lighting Memoranda" in the last issue. Mr. Cannan's paper was of a more general, and therefore

less pointed, character. He treated the proposition "in "the abstract;" averring that a municipality "ought to be "allowed to make a profit for the same reasons as a com- "pany are allowed to do so: (1) In order that they may "have some inducement to undertake the enterprise which "they would not have if they must take all risk of loss and "no chance of gain; (2) in order to secure efficient manage- "ment; and (3) in order that the economic proportion in "the production of different commodities may not be dis- "turbed." The author genially supposed that "the "arguments against profit-making in municipal enterprise "seem to be founded on an antiquated Socialism, or on a "false analogy, either from co-operative institutions or "from ordinary municipal work." At the same time, even Mr. Cannan was fain to admit that the highest possible profit should not be made in all cases. It is convenient to have this argument stated afresh. The practice of municipal trading at a profit is common enough in England to warrant anybody who approves of it in giving his reasons before a meeting of economists. Moreover, where it is followed to any extent, there is not much prospect of its being abandoned so long as any respectable excuse can be found for keeping up the system. It must be a source of satisfaction to the opponents of the system to learn how few and poor are the grounds upon which it is defended, even at a British Association meeting.

Take Mr. Cannan's first point—the supposed "induce- "ment" of the profit. Such a plea could never be urged save by those by whom the fundamental distinction between a municipality and a trading company or individual is completely ignored. Profit-making is the only proper motive of a commercial organization. What is the office of a municipality? Certainly not the same. Local authorities have to do all sorts of things, as their first duties, not only without thinking of making a profit, but at a positive charge to their localities. These things they must do. There are other things which they may do, if Parliament can be satisfied of the expediency of the undertaking. It is wearying to repeat the statement so often; but it is apparently necessary to observe once more that Parliament, acting in the spirit of the Constitution, has never regarded "profitable" and "expedient" as convertible terms in this connection. Mr. Cannan apparently has no idea of the bearing of the monopolistic character of a local enterprise upon the question of its suitability for municipalization. Where there is monopoly, the making of a profit is not controlled by commercial or by economical considerations, such as avail to protect the user or consumer of a marketable commodity. It is a matter of ruling and prescription. The municipalization of a monopoly can only be advocated logically in the public interest, which means getting the service performed at the cheapest rate. It is a small and mean view that there must be the inducement of profit-making to recommend an undertaking to a municipality. From this point of view, the members of the municipality ought to have a definite share of the profits, just like directors of trading companies, in order to keep them up to the mark in doing their duty to the community. Again, it is worse than a blunder—it is a positive insult—to suggest that there will be no good management of any municipal undertaking unless there are "profits."

Mr. Cannan's third reason is not a particularly clear one. He seems to imply that without profits there will be underselling; but here again he forgets the consideration of the monopoly involved in all municipal trading operations, and does not discuss the price of the service in the light of an indirect taxation. To put in a nutshell the whole case against municipal trading at a profit—the idea sets back the clock of public service to the days of turnpikes and the *ante* penny post period. Naturally, in the slow and painful process of the development of civilization, many things were done, at first, for the inducement of profit. Every public service was expected to be profitable to the doers of it, from the administration of justice downwards. Step by step, little by little, the work of the community came to be done with a view to the general good. This is the right way of it, whatever Mr. Pearson and Mr. Cannan may say, and a few reactionary municipalities still practise. A municipal department has certainly no more right to tax those whom it serves, than a member of a town council has to pocket a fee for doing his work honestly, and as well as he knows how, for the common good.

## WATER AND SANITARY AFFAIRS.

A SELF-REPRESENTATIVE deputation, consisting of four members of Parliament, one of whom was from Bradford and one from Romford, waited upon the President of the Local Government Board last Friday, for the purpose of holding what is called a conference on the subject of the scarcity of water in the East-end of London. These four gentlemen urged that the Department presided over by Mr. Chaplin should use its influence to induce the East London Company to make purchases of water from the other Companies "upon an adequate scale to meet the "present shortage." As we shall have occasion to remark farther on, there was no need to call upon the Local Government Board to make any such effort; the East London Water Company being busily occupied with the necessary arrangements for enlarging their resources in the manner proposed, some of the work being already done. Mr. Chaplin was also able to show this quaternion of advisers that his Board had been moving in the matter as far back as the month of May, and with good effect. In fact, the President said he had exhausted the powers of the Board, if indeed he had not gone a little beyond that point. Having already done so much, Mr. Chaplin went on to give "an emphatic assurance" that he would not fail in the future. He was even reported to have promised to obtain for the consumers "all possible compensation for the "distress and inconvenience they had experienced;" this being in response to a request that the Board should represent to the Company the justice of foregoing a claim for rates in respect of water which had not been supplied. Any such promise is repudiated by Mr. Chaplin; the question being one which rests with the Railway Commissioners. The claim for such a deduction from the water-rates is certainly not very encouraging for the Company. They are spending enormous sums of money in seeking to augment the supply, and are called upon to go on spending without stint, while at the same time they are to be penalized for not having done that which it was out of their power to do. When the account comes to be made up, we expect it will be found that to the Company the drought has been a very costly affair. Moreover, this suggested reduction of the water-rate would not be likely to benefit the real sufferers, but would serve as a gift to the landlords, who in most cases have not suffered at all. So far as the Progressive members of the County Council are concerned, they do not seem, as a rule, very partial to landlords. But, of course, the prevalent idea is to "hit" the Company, classed as among the "Water Lords"—an elegant phrase which, we believe, originated with the "Daily Chronicle."

On Saturday Mr. Chaplin received another dubious kind of deputation, professedly representing the East-end Local Authorities, but more distinctly apparent as having been organized by the Social Democratic Federation. Happily the occasion served to give the President of the Local Government Board an excellent opportunity of explaining the situation more fully. Particulars were given by Mr. Chaplin concerning the actual operations for connecting the mains of certain of the Metropolitan Water Companies, the effect of which will be to assist the East London supply to the extent of 12 million gallons per day, with the possibility of bringing up the quantity in aid to 16½ million gallons; thereby more than compensating for the previous falling off, estimated at 15 million gallons. The fear of a recurring deficiency may thus be dismissed. Mr. Chaplin declares himself decidedly of opinion that it is desirable to connect the mains of all the Water Companies in London; and he directs attention to the fact that this was one of the matters referred to the Royal Commission. It is interesting to learn—and it is a matter of no small importance—that, at Mr. Chaplin's instance, there is the prospect of an early interim report on this subject from the Commission. Respecting the policy of purchase, it is rather curious that the deputation failed to specify any particular body to whom the undertakings of the Water Companies should be transferred. No doubt the County Council is in view, and to that contingency Mr. Chaplin directed his remarks. He showed the difficulty of including the outer areas, and adverted to the physical obstacles in the way of a severance of the existing works. The wisdom of having made this one of the matters to be reported upon by the Royal Commission was evident. On all points, including the

charge of inaction on the part of the Government, the contentions of the deputation were well met; and Mr. Chaplin's reply will stand as a very able and impartial exposition of the important subject of the Metropolitan Water Supply. The question is one which cannot be precipitated, pending the report of the Royal Commission; and the present duty is to carry out those arrangements already in hand which will protect East London from the effects of another dry season. The proposed autumn session for dealing with the Metropolitan Water Question was shown to be a useless expedient. In reality, it was an absurd proposal, congenial to the extreme notions of the Social Democrats.

While progress is thus being made to restore the full water supply of East London, there is an attempt to show that the water sent out by the East London Company is peculiarly deficient in quality. "The Times" having stated that the returns for "last month"—that is August—showed that the East London supply, so far from being the worst in the Metropolis, was rather the best, the "Daily Chronicle," followed by "London," undertook to prove the contrary by referring to the reports for July—asserting these to be "the last." If our contemporaries will avail themselves of the reports for August, issued before their remarks were made, they will find ample justification for the statement in "The Times." But, of course, they rely on General Scott's report, which is always somewhat (doubtless unavoidably) late—that for July appearing on Sept. 7. Yet these very astute gentlemen, who undertake to correct the correspondent of "The Times," might be expected to consult the almanack sufficiently to know that July is not the month that comes immediately before September, and might be supposed to understand that July data do not necessarily correspond to those of August.

The Hackney Vestry, after inveighing against the East London Water Company and invoking the powers of the Railway and Canal Commission under Mr. Chaplin's Act of last year, were found on Friday last so unprepared with their case as to be unable to submit to the fixing of a date when it should be heard. The Company, represented at the sitting of the Commission by Mr. Cripps, Q.C., were ready, and were anxious that a hearing should take place early in October. But the Commissioners were not disposed to move out of their ordinary course unless it were for the public good, and in order to deal with some really urgent matter. All they could see was that the East London Company were, as Mr. Justice Wright intimated, anxious to have the matter settled, in order "so to speak" to "clear their character." The Local Authorities were not in a position to require prompt hearing; and there was nothing to show that the interference of the Commission would result in immediate advantage to the inhabitants of the district. The Company were pressing, and not the Authorities. Accordingly the Commissioners resolved to let the matter stand over. This incident, among others, serves to show the utter unreality of the agitation which has been raised in Hackney and other East-end parishes in respect to the water supply. The wire-pullers are at work, seeking to promote a purpose in which the County Council comes first, while the consumer stands a long way second. Mr. Beachcroft puts the case well, in the course of the controversy going on in "The Times," when he says that the real question for consideration is how the failure of the water supply may be rendered impossible in the future; whereas Mr. Stuart is, on the other hand, considering how to utilize the failure for the discomfiture of the Water Companies.

Plymouth, we may presume, is now at the end of its troubles with regard to its water supply. In 1894, the leat, associated with the memory of Sir Francis Drake, was superseded by a pipe-line; and on Wednesday last the completion of a large storage reservoir, situated a dozen miles from the town, was duly celebrated. The open watercourse which for generations brought the waters of the River Meavy to Plymouth, was apt to be blocked by frost and snow; and more recently the supply was affected by drought. At a cost of £175,000, Plymouth will now have the benefit of a big reservoir, nearly a mile and a half long, and half a mile across at the widest part. A dam rising 77 feet above the bed of the river now intercepts the flow of the Meavy, and will store 650 million gallons of water—a sufficient supply for about 130 days. At the quaint ceremony observed on Wednesday—ancient in its origin, and now at an end—after drinking in water to the pious memory of Sir Francis Drake, the Mayor and Corporation drank in wine the second toast of the annual fishing feast—"May the descendants of him who brought "us water never want for wine." We trust neither reservoir nor pipe-line will fail, and that Plymouth will never want for water.

## ESSAYS, COMMENTARIES, AND REVIEWS.

### GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 709.)

THERE is still no improvement to be noted in the tone of the Stock Markets, but rather the reverse. Last week certainly gave a little promise of amendment at the opening; but it soon came to naught. This was owing largely to the apprehension created by the Pekin *coup d'état*, cumulated upon the already disturbed condition of foreign affairs, and to the increasing drain upon our gold reserve. So things fell very flat; and they continued thus to the close, with the result that prices in all the chief departments show a moderate drop. On Thursday, the Bank Directors raised the rate from 2½ per cent. (fixed on June 30) to 3 per cent. This was not universally expected—indeed, up to Wednesday night, many thought that a rise would not be necessary. In the Gas Market, business scarcely maintained the level of activity which it had reached the preceding week, though that was nothing extraordinary; but there was no sign of shrinkage in value for lack of support, and the general tendency was steady. Changes in quotation were very few and unimportant. In Gaslights, the "A" was moderately active, and, despite the prevailing torpor, advanced a point. Actual prices realized were quite level from day to day, never varying more than a point or so above or below 294. The secured issues were moderately dealt in, and were steady, but without any promise of an advance. A small amount of business was done in South Metropolitan; but prices were no better than moderate. Commercials were not touched, intending sellers probably waiting until after the Company's meeting next week. There was a shade more doing among the Suburban and Provincial Companies; and prices for the most part were very good, though quotations did not move. The Continental undertakings were very quiet. The only one to move was Union, the preference shares of which had a fall. Among the minor undertakings in the remoter world, there was nothing to call for remark. Business in the Water Companies was of the most limited proportions; and movements in value were as slight and unimportant. The most noteworthy feature was that East London, after dropping down to 212½, had a rally, and recovered a couple of points of its loss.

The daily operations were: Business in Gas on the opening day was fairly brisk—perhaps more active than on any other day later in the week, and prices were favourable. Gaslight "A" advanced 1. Transactions on Tuesday were extremely limited; and quotations did not move. In Water, East London fell 3. Wednesday's operations showed that good steady prices were obtainable; but still the figures did not advance. The characteristics of Thursday were much the same—steady prices, but no rise in them. In Water, East London recovered 2. On Friday, business in Gas continued at about the same level, and figures remained about the same; but Continental Union preference fell 2. In Water, Southwark ordinary was 2 lower. Saturday's business was brisker than usual; but no change was apparent beyond a further fall of 2 in Union preference.

### ELECTRIC LIGHTING MEMORANDA.

**Electricity at the British Association—Electrical Plant Culture—Electrical Power Transmission.**

ELECTRICAL subjects bulked largely at the British Association meeting. There was a special joint conference during the meeting, of an international character, to discuss the still unsolved problem of how to prevent the strong currents employed in tramway and railway working, and for power transmission, from doing mischief outside. The subject is dealt with at greater length in another column; but it was agreed that even the Board of Trade regulations have not removed the risk of electrolysis from gas and water mains and services in localities where these currents exist. Many other topics of an electrical nature were brought before the British Association, chiefly in Section A; and it is again proposed that a new section should be formed to take up this branch of physics. The chief objection to the proposal is mentioned and admitted by the "Electrician." This is the poor quality of many electrical papers sent to the British Association. If there were an electrical section, there is more than a probability of its being a desert for the greater part of the week. The electricians who are in the habit of attending the meeting would never make an audience for one another. They know each other too well. With the present arrangement, an electrician can reasonably hope to catch the

ear of somebody besides the chairman of the section—at any rate, to begin with. Lest it should be thought that jealousy inspires our remarks upon this head, we will repeat what the "Electrician" has to say of the electrical papers read before Section G. "It has been the excellent custom for some years past to set apart Monday for these papers; but the average quality of the communications on such occasions is decidedly disappointing. Now and again a real advance in engineering science is marked by the reading of a thoughtful and suggestive paper; but not uncommonly the contributions are a miserable re-hash of antiquated platitudes, an oft-told tale that bores the electrical engineer and affords no practical information to engineers of a different sort." This is very sad.

The Presidential Address of Sir W. Crookes having dwelt upon the prospect that nothing but electrically produced nitrate of soda will avail to preserve the world from starvation in the not-distant future, there was a certain appropriateness to the general question in the papers of Herr Lemström and Dr. E. H. Cook on the influence of electricity on growing plants. This is a subject that greatly occupied the attention of the late Sir W. Siemens. The electrical production of a fertilizer to be applied to the earth in the humdrum way of ordinary farming, is a comparatively tame idea to that of growing crops directly by electricity. Herr Lemström says that by his electrical treatment "there has been in general an increase in the seeds of at least 40 per cent.; in the roots, from 25 to 75 per cent., depending on the kind of plant and on the nature of the soil; beans, 75 per cent.; and strawberries and raspberries, as high as 75 per cent., and the time for their ripening shortened at least one-third." It can only be said of this story that it is too good. Dr. Cook stated that electrification appeared to accelerate the germination of seeds; but low-power currents had no effect upon the plants afterwards. High-voltage currents seemed to act much better upon growing plants. After hearing both these papers, however, the President of the Section (Professor Ayrton) said he had not made up his mind that plants materially benefited by electrical treatment. Lord Kelvin followed on the same side; freely avowing his fear "that the chance of agriculture really benefiting was very remote." All the same, there must be allowed to be something in Lemström and Cook's results which calls for further investigation. The British Association ought to appoint a committee to look into the matter. Meanwhile, such of our readers as have gardens may like to try for themselves the arrangement described by Dr. Cook as a French invention for the application of atmospheric electricity to plant growing. It is called the "Géomagnétifère," and is practically a lightning conductor set up in the middle of a field, and connected below with a series of cross wires running under the soil near the roots of the plants. Dr. Cook vouches for the fact that in a kitchen garden on Clifton Hill this year, one of these arrangements produced a distinctly beneficial effect upon the crops. Are nitrate of soda and sulphate of ammonia to be disestablished by direct electrical action?

It is remarked by an electrical contemporary that much bitterness was imported into the debate at the British Association upon certain papers on electrical power transmission. Mr. Alexander Siemens gave a temperately worded account of the actual position of this branch of electrical engineering. He believes that electricity will, in the near future, supersede steam, horse, and cable traction for tramways. He admitted that it would be advantageous if alternating electric currents could be employed for tramway working, by reason of the ease of transmitting the power from a distance and the simplicity of the transformers. But there is as yet no reliable alternate-current motor available. Such motors certainly exist; but unfortunately up to now they refuse to start without being first synchronized by external means, they are liable to stop abruptly when overloaded, and their speed cannot be varied. A great step towards the solution of the problem was made when the three-phase system was hit upon; but, on the other hand, a continuous-current system is decidedly simpler, and consequently cheaper in first cost and maintenance. There is such a plant at the Charlton works of Messrs. Siemens Bros. and Co., which gives satisfaction, although the motive power costs 2d. per unit. This is rather dear; and the "Electrical Review" draws from the statement the comfortable inference that public electricity supply undertakings may hope to do a good business of this kind, even with large engineering works. Mr. Gibbings, the Electrical Engineer to the Bradford Corporation, read an instructive paper recounting how the use of electric motors is being encouraged in this town; and then, it appears, Professor Silvanus Thompson fell upon the meeting and the "direct-current" men with a root-and-branch condemnation of their methods, and declared that the three-phase alternating system is going to supersede everything else of the kind. This declaration did not command the assent of all the other learned and eminent professors who had foregathered at Bristol. Professor Thompson appears to have posed at the meeting on more than one occasion as a prophet of the three-phase system; but he did not succeed in convincing everybody that all direct-current plant should be relegated to the scrap-heap. Hence the "bitterness" spoken of by our electrical contemporary as poisoning the air of the Section of Mechanical Science. Your electrical prophet does not like a sceptical audience; and electricians, when not prophesying on their own account, are apt to be impatient of their fellows who so employ themselves.

## THE BRITISH ASSOCIATION AND ELECTROLYSIS OF GAS AND WATER PIPES.

British gas engineers and gas-works proprietors are not troubling themselves over the prospect of a great expansion of electric traction in populous places which is unquestionably opening before the people of this country. Home readers of the "Journal" know, in a general sort of way, that gas undertakings in America are sometimes afflicted with a disease of their distributing system called electrolysis, traceable to the action of electric traction currents; and there was a brief time, when electric tramways were first started in England, when there existed some disquietude on this account. The Board of Trade, however, intervened with a model set of regulations; and the threatened owners of buried property in the shape of gas and water mains straightway composed themselves to rest in security behind the great department. It therefore came as an unpleasant surprise, when Professor A. W. Rücker, presiding during the meeting of the British Association over a conference on Terrestrial Magnetism and Atmospheric Electricity, stated that the problem of the wandering currents of electrical traction systems is still open. "The science of terrestrial magnetism, which, on the one hand, is forging another link to connect the sun and earth, and, on the other, is penetrating within the surface of the globe to depths beyond the ken of the geologist, is threatened by the artificial earth currents of the electric railway." So far, serious as the crisis may be, it is not a matter for anybody but magneticians to agitate about. They are not disposed to be selfish, and will certainly not be so foolish as to set themselves against the extension of electrical railways, which will confer vast benefits upon the community at large. The trouble, however, though they are the first to discover it by reason of the delicacy of their instruments of research, will not be confined to them; but what upsets a magnetic observation to-day, may perforate a gas or water pipe in the course of time.

Professor Rücker declares that "we are now at the beginning of another industrial epoch which may, indeed, if power is transmitted from a distance on a large scale, brighten our skies, but which threatens to saturate the earth beneath us with electric currents. That these may interfere with the general comfort, is evident from the injury which has been done to underground pipes at Washington and elsewhere." The subject was subsequently discussed at a joint meeting of physicists, engineers, and magneticians. It appeared, from what was stated on this occasion, that magnetic observatories succumb to electric railways within three miles. In the case of a proposed electric railway at Kew, the magnetic observatory is to be protected by complete insulation throughout the district, and the two conductors are not to be separated by one-hundredth of the distance of either of them from the observatory. Mr. W. H. Preece spoke of the need for making electric lighting and traction currents, as the latest comers in the land, subservient to regulation in the interest of the safety of older public service appliances. Taking the case of the City and South London Railway, upon which a very close watch has been kept, Mr. Preece said that the whole of London had been found disturbed by the currents of this railway. There seems to be considerable leakage "due to the use of the earth, and also to the fact that the third rail, from which the current was picked up, was badly insulated." He called special attention to the fact that "in no single instance was the disturbance such as could not be remedied by taking simple and ordinary precautions." This is reassuring; but the question remains as to what is likely to happen if these precautions fail. At Bristol, Major Cardew's suggestions and Mr. Parshall's improvements on the service methods of the electric tramway have had a very beneficial effect, "reducing the maximum disturbance to slightly exceeding one volt." If ever the Metropolitan Railway is worked electrically, it will be necessary to make it a complete metallic circuit. "The use of the earth is a vested interest for the whole nation;" and electric tramways and railways must not monopolize it.

Unfortunately, when electrical traction was thus called upon to show cause why it should not be bound over to keep the peace towards other services, the electricians and engineers who might have undertaken the defence of the accused were not present. This is greatly to be deplored, more especially as Dr. J. A. Fleming had a paper on the subject of the electrolytic corrosion of water and gas pipes by the return currents of electric tramways, the conclusion of which was "that even working under Board of Trade regulations, it must not be assumed that the danger does not exist." This is a grave statement. Dr. Fleming's paper is not suitable for complete reproduction in our columns; but we can give a summary of its contents. Referring to the sixth regulation of the Board of Trade Order, under which electric traction is actually carried on in the United Kingdom, the author explains it to mean that where a pipe is found to be negative to the rail the potential difference is not to exceed 4·5 volts, or if the pipe is positive to the rail the potential difference must not exceed 1·5 volts. Generally speaking, the danger areas are those in which the pipes are positive to the rails, and where a resulting current flows out of the pipe into adjacent electrolyzable soil. Assuming that the Board of Trade regulations are obeyed, the next question of practical moment is as to their sufficiency for the

prevention of mischief. Dr. Fleming accordingly tested the conductivity of some London clay, taken from a street opening made for main laying. He also tested in the same way some damp sand, and cement concrete—all common road-making materials. He found from his observations that a continuous flow of electricity, not exceeding 1·5 volts, may amount to something very considerable in the course of time between metallic surfaces of large area buried in the soil. Moreover, a large proportion, perhaps the whole, of this flow must be carried by electrolytic conduction. In such circumstances, a pipe would be electrolytically attacked. If the surrounding soil is of a nature to favour electrolysis—that is, if moisture and salts are present in it—a far less difference of potential than the maximum of 1½ volts permitted by the Board of Trade can produce rapid corrosion of iron. Several experiments were described by Dr. Fleming as proving that "quite small potential differences—much less than a single volt—between iron surfaces buried in damp soils, especially if soluble chlorides are present, may bring about considerable electrolytic erosion in no great periods of time; and that there is no absolute security in the limit of 1½ volts imposed by the Board of Trade regulations."

It was felt desirable to test the matter with actual water-pipes, on a somewhat large scale. Accordingly at Dr. Fleming's suggestion an experiment on 5-inch water-mains was arranged at the Bristol Water-Works, by Mr. H. W. Pearson, the Engineer of the Water Company. The arrangement was as follows: Three exactly similar 36 feet lengths of the piping, jointed and laid as for a water-main, were buried side by side in a non-acid sandy clay soil. One row of pipes was neutral, and was intended for the basis of comparison. Between the other two lines of pipes a difference of potential of 1 volt was kept up day and night for six months, after which period all the pipes were dug up and examined. The pipe which had been connected to the negative pole of the battery was of a clean, grey colour, with hardly a trace of oxidation. "The pipe length which had been connected to the positive pole of the cell was uniformly covered with a layer of orange-yellow oxide of hydroxide of iron, in some places of quite sensible thickness and easily detached. . . . . The appearance of the pipes clearly indicated that electrolytic action had taken place." If the action, instead of being general over the surface of the pipe, had been concentrated upon one spot, the damage would have been more serious.

If a pipe-line were homogeneous throughout its length, it would be a good conductor—much better, at least, than the ground which surrounds it. The resistance offered by bad or oxidized contacts at the joints, or by films of moisture, paint, or preservative compound, may altogether outweigh the resistance of the mere run of pipe material. The resistance could not be estimated. It is probable that, whereas in some cases the conductivity of long lengths of water and gas pipes may be fairly small, in others oxidized or electrically bad joints will introduce great resistance. "We have, however, to regard the subterranean pipes of all kinds as forming a network of conductors, interrupted more or less at places by junctions of high resistance, but, on the whole, most probably forming an irregular conductor system of greater conductivity than the soil or earth actually displaced by it, or which would occupy the same space if the pipes were not there."

Dr. Fleming then proceeded to discuss the conditions likely to prevail in the vicinity of an electric tramway on the trolley-wire system. Where such a system of tramway is worked on the rail return principle, it is inevitable that there will be some flow of current through the earth, however carefully the rails may be bonded. It is practically impossible to foretell what may happen in the case of an actual tramway in regard to this vagrant current. The best contemporary American practice has given up reasoning about it, and is content to deal with mischief when it shows itself. The trouble is that the current will in some places leave the rails and go to the pipes, and in others will quit the pipes for the rails. Local conditions, such as the dampness or salinity of the soil, may largely influence the effect, which may prove out of all proportions to the theoretical expectation based on the measured loss of current. Even if actual perforation does not occur, the life of the pipes may be shortened by the action brought to bear upon them. Lastly, "as the conditions determining possible pipe corrosion are numerous, and not all easily predetermined, it is important in the case of every electric traction system with uninsulated earth returns, that an electrical survey should be made at intervals, setting down on a plan showing rails and pipes, the potential differences between them at various places. Within the danger area a close watch can then be kept, when the ground is opened up for any purpose, for evidence of destructive electrolytic action on buried pipes." This is by no means a reassuring prospect. It seems to be the latest word of science on the subject. When continuous currents are abolished, and railways are worked by three-phase alternating currents in insulated conductors, there will be no danger of electrolytic action. This relief is not yet to hand. In the meantime, it is acknowledged by the "Electrician" that adequate provision will have to be made for the protection of scientific research and of actual property in the vicinity of the lines, the security of which might otherwise be menaced by the magnetic and electrolytic effects of the traction currents. Such protection, it is considered, is best to be found in the adoption of "an insulated return conductor placed in such a position relatively to the supply conductor" as will reduce outside effects to real insignificance. This is a point to be borne in mind in connection with future Electric Railway Bills. Electric traction is certain to come, and will probably have a great future in this country. But there is no good reason why its progress should be at the expense of gas and water distributing plant, to say nothing of telegraphs, telephones, and the case of magnetic observatories. Much interest will attach to the experience collected with respect to the working of the pioneer lines in Bristol and Leeds.

## INCLINED RETORTS ON THE CONTINENT.

THE report of the Commission of the Association of German Gas and Water Engineers appointed to collect all available information on the use of inclined retorts was presented by Herr Reissner, of Berlin, to the general meeting of the Association, and was briefly referred to in our notice of the proceedings at that meeting (*ante*, p. 201).

The striking extension of the inclined retort system on the Continent, which is indicated by the fact that settings for 2655 of these retorts are in course of erection, while only 1393 such retorts are already in use, calls for further comment. As a matter of fact, the bare statement of the totals is misleading, owing to the present curious position of the gas industry in Vienna. The Imperial Continental Gas Association have had for some few years 108 inclined retorts at their works in the city; and had they been assured of the continuance of the use of these works, more slopers would doubtless have replaced horizontal retorts as opportunity arose. But under the prevailing circumstances, the Imperial Continental Gas Association have refrained from introducing new settings of inclined retorts at their Vienna works. The authorities of the city, however, have taken in hand the construction of settings for 1620 inclined retorts at the new municipal works now in course of erection. This gigantic installation, when completed, will remove all ground for the belief of some few gas engineers that inclined retorts are still only found in one or two experimental benches in works in which the bulk of the carbonizing continues to be carried out in horizontal retorts.

When the 1620 retorts which are about to be set in Vienna are taken from the grand total of 2655 inclined retorts in course of erection on the Continent, only about a thousand remain to represent the contemplated increase in the use of the system in other Continental towns. This number, however, is nearly equal to the number at present in use, and therefore indicates a very rapid extension of the system. In most cases an addition to the number of existing settings of slopers is being made; but in a few towns they are about to be adopted for the first time. For instance, at Zürich, settings for 144 inclined retorts are being erected as a first instalment; and both at Malmö, in Sweden, and at Frankfort-on-the-Maine settings for 72 retorts will serve to introduce the system. On the other hand, the number of inclined retorts at the municipal gas-works at Berlin is being increased from 54 to 315; and at Milan an addition of 144 to the existing 72 is being made. The Cassel installation of 108 retorts has already formed the subject of an interesting report;* and it is pleasing to notice that the number is being increased to 153.

The report presented to this year's meeting of the Association was supplementary to the exhaustive one made by the Commission of the Association last year.† No detailed descriptions of the settings are given in the present report. The Commission had been requested at last year's meeting to consider the question of the validity of the patent rights for inclined retorts in Germany,‡ and to express an opinion as to what would constitute infringement. This request had been made on the motion of Herr Grahn, of Hanover. The Commission unanimously decided to advise the Association not to take up the consideration of questions of patent rights, as they did not appear to come within the legitimate sphere of action of the Association, and might conceivably involve them in a large expenditure. This attitude of the Commission called forth adverse comment from Herr Grahn; and the discussion on the strictly technical portion of the report was thus thrown into the background.

## RODDA'S "NOTES ON WATER SUPPLY."

A FEW years ago, a series of articles and notes on the subject of water supply were contributed to the "JOURNAL" by Mr. J. T. Rodda, of Eastbourne; and their publication gave rise to an instructive discussion on the various points brought forward. The author has reprinted them in book form,§ accompanied by a number of useful tables, memoranda, and illustrated descriptions of appliances, tools, and materials required on a

* See "JOURNAL," Vol. LXIX., p. 1500.
† *Ibid.*, Vol. LXX., p. 795. ‡ *Ibid.*, Vol. LXX., p. 164.
§ "Notes on Water Supply, containing References, Tables, Notes, Memoranda, and Detailed Advertisements in Relation to Water-Works Engineering; also Illustrated Descriptions and Prices of Apparatus, Appliances, Tools, and Material required on a Water-Works." By J. T. Rodda.

water-works. The book has no pretensions to being a treatise; the object being rather to point out the specialists from whom valuable information may be obtained, and to indicate as far as possible the best water-works appliances in the market, with notes thereon. The distribution of water on the most modern systems is of vital importance, and demands the serious attention of all those who are entrusted with the care of a public supply. It is not to be expected that all the details of design and construction of the most recent plant and appliances can be acquired without close application and research; and therefore it is imperatively necessary that a competent hydraulic engineer should be consulted—one who has acquired his special knowledge from many years of study and experience.

Mr. Rodda gives a number of new and very useful tables, formulæ, and rules, which have been worked out by him specially for this book; and they will be found of the greatest value to all engaged in carrying out water-works. One of the tables may be mentioned. It gives the approximate relative discharging powers of full smooth pipes from 2 to 50 inches in diameter. This will facilitate the proper proportioning of pipes for distribution—a work which is often done by rule-of-thumb. Other tables relate to the delivery of water in pipes, the loss of head through friction, the pressure of water in pounds per square inch and feet head, weights of pipes and specification therefor, and modern rules and regulations. The abolition of cisterns in dwellings at the East-end of London—a matter which is now engaging a considerable amount of attention—is dealt with in an article entitled "Cisterns a Necessity." There are some practical notes on the Worthington pumping-engine, meters, and most of the machinery and appliances used in water-works, including patent stopcock boxes, &c. The descriptive advertisements of the manufacturers selected being printed on the left-hand pages, opposite the notes referring to their specialities, illustrate the text as fully as possible, and direct the attention of the reader to reliable manufacturers or specialists for the particular work described.

The index is a unique feature. All the manufacturers' names, with their leading specialities as advertised, as well as notes, are indexed; and sufficient space is left for the addition of notes, memoranda, and formulæ. This will help to make the book a standard work of reference, and cause it to be in constant requisition by the office staff.

## PERSONAL.

On the nomination of Mr. G. H. Hill, Mr. M. R. Barnett has been appointed Resident Engineer for the Cray Water-Works of the Swansea Corporation, at a salary of £450 per annum.

Mr. F. G. Pullinger has resigned the secretaryship of the Edenbridge Gas Company, having taken a business at Sevenoaks. Last Tuesday evening the Directors appointed Mr. C. Cheal as his successor.

Mr. W. Wyver, who has for several years held the position of General Foreman at the works of the Whitstable Gas and Coke Company, Limited, has now been appointed Working Manager for the Company, and also for the Water Company.

## OBITUARY.

Mr. C. H. Dudley, who for some time was Chairman of the Stafford Corporation Gas Committee, died yesterday week. For many years he had taken a prominent part in the public work of the town. He became a member of the Town Council in 1880; and the following year saw him in possession of the highest office his colleagues could confer upon him.

The death is announced of Mr. George Mather, who was connected for many years with the Stockport District Water-Works Company in various capacities, ultimately filling that of Secretary, which position he held until his retirement a few years ago. Mr. Mather was 77 years of age. Since he gave up active work, he has resided at Buxton, where he died on Monday last week.

We regret to record the death, on the 16th inst., after a short illness, of Mr. Joseph Phelps, Engineer and Secretary of the Marlborough Gas Company. Mr. Phelps was a native of Marlborough, and for 34 years held the above-named positions, as well as many important offices in the town, in which he had an ironmonger's and gas-fitting business, which his Directors allowed him to carry on—thereby showing their great confidence in him. He was elected a member of the British Association of Gas Managers in 1867, and was a regular attendant at the meetings of that body and subsequently of The Gas Institute—only missing the last through a slight ailment. His death took place at his brother's residence at Brixton; and he was buried in the family vault in Marlborough Cemetery. The funeral was attended by a large number of his fellow-townsmen, as well as by the whole of the Church officials and Sunday-school teachers—Mr. Phelps having been Honorary Organist and Superintendent for 35 years; and general testimony to his worth was shown by the closing of business places at the time of the ceremony. Deceased was a Freemason; and two of his brethren in the gas profession (Mr. F. C. Taylor, of Shanklin, and Mr. J. J. Jervis, of Swindon) followed his remains to their last resting-place. Mr. Phelps was 68 years of age; and he leaves a widow.

## NOTES.

### Exposure of the Jacques Carbon-Battery.

An exhaustive test of the Jacques carbon-battery, in which, as claimed by the inventor, coal or coke is converted directly into electricity, has been made by Messrs. Rosewater and Oldham, as reported in the "Journal of the Franklin Institute." The patentee claims for the cell an efficiency of 32 per cent., instead of the present duty of 6 or 8 per cent. The apparatus consists of a closed furnace, which heats an iron pot 6 inches in diameter and 2 feet deep, filled with caustic potash or soda kept in the molten state. In the alkali bath is suspended a carbon rod, which forms one electrode of the battery and is the consumable element. Air is at the same time blown through the bath, to keep it in constant agitation, and help to supply oxygen. These cells undoubtedly supply current; but in stating its efficiency, the inventor used to leave out the weight of fuel consumed in keeping the pots hot. Jacques asserted that the generation of current was due to the chemical combination of the oxygen of the air with the coke in the electrodes; but this statement was disputed. The latest experiments show that the cause of the current is thermo-electric, and not chemical or galvanic. When coal gas was blown into the alkali bath instead of air, the current came off just the same; and the substitution of copper or iron for coke as the consumable electrode, made no difference to the voltage. Hence it was concluded that the cause of the direct conversion of carbon into electricity had not been materially advanced by the Jacques battery.

### The Protection of Lead Water-Pipes.

In a recent number of the "Zeitschrift für angewandte Chemie," M. Liebrich published an account of the causes of the action of water on lead pipes, and the means of its prevention. After showing how the opinions of different authors vary on this question, he states that his experiments, made with water characterized by the absence of carbonates and by a relatively large proportion of organic substances and nitrates, enabled him to establish the following points: The essential causes of the attack on lead are due to the action of oxidizing substances (air) and acid (carbonic acid). The presence simultaneously of two agents, oxygen and carbonic acid, is requisite; for, removing the oxygen with sulphite of soda, excess even of carbonic acid does not dissolve the lead. On the other hand, the dissolving action of oxygen also disappears by the removal of carbonic acid. According to the author, distilled water laden with air and carbonic acid acts powerfully as a lead solvent—a fact which demonstrates that if salts of drinking water have any action at all, it is at least a very limited one. Presence of bicarbonate of lime in water checks the dissolving action, as it seems to exclude the formation of lead and zinc carbonates. There are cases where, air and carbonic acid being present, even very hard water attacks pipes; but the action is then relatively slighter. M. Liebrich found that the addition of carbonate of lime decreases, it is true, the dissolving action on the metal, but does not arrest it completely. By adding carbonate of soda in just the necessary quantity to fix the carbonic acid without rendering the water really alkaline, the author succeeded in preventing all dissolving action on lead. He admits that if during the day, when the water flows relatively quickly, the amount of metal in solution is very slight, it is not so in the morning after the night's repose. He concludes by recommending the use of carbonate of soda.

### The Purification of Drinking Water.

In such seasons as that with which this country has been visited for three years, much interest attaches to the subject of a recent leading article in the "Engineer," which dealt with the question of the foulness of water supply that usually accompanies diminution of volume. The worst feature of a severe drought is that what water there is generally becomes exceedingly impure, for a variety of reasons. The question therefore arises of how this dirty water should be treated, when the usual method of filtration on a large scale fails. The most obvious remedy is boiling the water intended for drinking, in order to destroy the germs it may contain; but the expedient is not to be relied upon, and the result is to render the water distasteful. The other extreme of treatment—freezing—is hygienically worthless. The common domestic filter has long been discredited. Porous filters of porcelain or asbestos give much trouble; and there is great risk of cracking, and so rendering them useless, in the process of cleaning. Chemical processes of water purification are open to many objections. The iron system is good, where it is applicable; but it is not superior to the lime and iron disulphide method. Alum is of ancient repute as a purifier of water; but even when combined with lime, it is slow in action and of limited efficacy. All the processes depending upon the employment of permanganates are marked by serious disadvantages. Besides, they tint the water, leave deposits, are costly, and the water so treated is very unpleasant to drink. The writer falls back upon a suggestion of M. Henri Bergé to the Société des Ingeneiurs et des Industriels. After studying the whole question of the sterilization of water, this author observes that a little-known gaseous compound, peroxide of chlorine, possesses powers exceeding those of ozone in this regard. The peroxide will keep well in pure water, so long as it is not exposed to light and the temperature is low; and

if there is organic matter in the water, it will destroy it. The action is so intense that $\frac{1}{300}$th of a grain will sterilize 1¾ pints of water. The compound is prepared by decomposing potassium chlorate at an ordinary temperature and at 64° Beaumé. This gas, so destructive to microbes, is stated to be perfectly harmless to human beings and animals.

### The Coal Supply of the United Kingdom.

The probable duration of the coal deposits of the United Kingdom formed the subject of a paper read by Mr. T. Forster Brown before the Mechanical Science Section of the British Association. In it the author pointed out that, though our coal resources extend over wide areas, it is the most available and the most valuable seams which are first attacked and exhausted. These are the veins workable by free drainage levels, without pumping or winding; and this was the main source of our coal supply up to about the middle of the present century. Next follow the best of the thick seams at a moderate depth, which will for a considerable time be the principal source of the existing supply. There remain the thin and inferior seams existing at shallow depths, and all seams at 2000 feet or so, down to the extreme limit of workable depth. These larger resources are still practically intact. The author contended that it is not the amplitude of our total coal resources which gives the limit, in time, of our commercial supremacy; but it is probably the duration of the best and cheapest deposits only that is the true measure of the national prosperity. The author accordingly estimates that a total of 66,683 million tons exists in the region of best coal. He further estimates that $\frac{11}{12}$ths of our best resources will be exhausted about the year 1950, when the whole annual output will be made up in rapidly increasing proportion of deep, thin, or inferior coals. There will then remain coal workable at a gradually increasing cost sufficient for the supply of the nation for a period of upwards of 250 years. The suggestion is that in the meantime the capital cost of railways and other undertakings dependent upon a good and cheap coal supply should be redeemed. "On the other hand, if the nation will do nothing to guard against the danger of commercial collapse, which will take place upon the exhaustion of our cheaply-worked coal, we shall be in the position of being saddled with the large amount of capital invested in railways, docks, and public works, amounting at the present to 1500 millions sterling; the cost of manufacture will rise; and Great Britain must gradually sink into the position of a secondary power." Among other vanished benefits, it is to be supposed that coal gas of 16-candle power and upwards will be included; to say nothing of sliding-scale dividends.

## COMMUNICATED ARTICLE.

### A FEW HINTS ON CARBONIZATION.

By S. Carpenter, of East Ham.

In offering to students and young gas managers who have just entered the gas profession, a few hints on carbonization, the writer's advice first would be this: Look well to the beats of the retorts, and keep them at a bright red. Do not have them at a too high heat, as it will be detrimental to the illuminating power of the gas, and stop up the ascension-pipes. The retorts must be kept at a bright red heat, so as to well carbonize the coal, and keep sufficient vacuum on the hydraulic main, to take away the gas as quickly as possible, so that there may not be any undue pressure on the retorts, as this would cause them to scurf, and obstruct the ascension-pipes. Have pressure-gauges on all the outlets of all the apparatus through which the gas passes; and if possible, bring them all into a room, fix them side by side, and keep them in good working order, as they are the key of the works. If at any time there should be a stoppage, the gauges will indicate its locality.

For the benefit of those who may not have had an opportunity of testing coal for the quantity and quality of the gas distilled from it, the writer ventures to offer a few remarks. Those who have analyzed coal know well what it is composed of; but the writer has often been asked the question. Coal is often spoken of very slightingly; but it is a very important factor in manufacture in general. It is composed of the following ingredients: Carbon, hydrogen, nitrogen, oxygen, sulphur, and iron. By putting the coal into a retort at a bright red heat, its normal condition will be disturbed. During its distillation, the coal yields coke, carburetted hydrogen, hydrogen, ammonia, bisulphuret of iron, and various basic hydrocarbons, photosulphuret of iron, tar, and water. Casting a glance at the composition of coal, we shall see at once the origin of the various products obtained by distillation at a bright red heat. Thus we are able, in a tabular form, to observe the original and subsequent order of arrangement which takes place on disturbing the normal condition of the coal. After all the volatile matter has been driven out of the coal in the retort, the excess of carbon remains as coke, which holds the protosulphuret of iron driven off from the decomposition of the bisulphuret contained in the coal. Part of the hydrogen remains free; part combines with carbon, giving rise to various kinds of hydrocarbon, such as gas, naphtha, and tar; while another part combines with some of the sulphur of the bisulphuret of iron and any free sulphur present in the coals to form sulphuretted hydrogen. The rest unites with oxygen to form water, or with nitrogen to produce ammonia; the remainder of the oxygen being taken up by part of the carbon, generating carbonic oxide and carbonic acid.

It has been said that the formation of bisulphide of carbon is altogether a secondary action. But the writer has not found it so. It is produced in the first hours of the distillation of the charge of coal, but in very small quantity. It is in the last hours when the generation of volatile matter begins to lessen, and the coke commences to form, that the bisulphide of carbon increases. At this stage of the distillation the bisulphide of carbon is given off from the newly-formed coke, which holds the protosulphuret of iron derived from the decomposition of the bisulphide. After expelling the volatile constituents of the coal, if the heat is still made to act upon the residual coke, the bisulphide of carbon makes its appearance very freely. If the original dip-pipes are used, and a good tar seal is kept up in the hydraulic main, a portion of the bisulphide of carbon will be retained in the tar. Bisulphide of carbon is a sulphur acid, and as much of it as possible should be removed from the gas. As coal gas is so generally used for illuminating purposes, it should be made as pure as possible.

The impurities which are present in crude gas, and require removal, are ammonia ($NH_3$), carbonic acid ($CO_2$), sulphuretted hydrogen ($SH_2$), and bisulphide of carbon ($CS_2$). They are not only useless but injurious; and it is very important that they should be taken out of the gas. Carbonic acid is incapable of supporting combustion or life. Hence it is not only useless, but exceedingly deleterious to the illuminating power of gas, and very hurtful to animal life, even when largely diluted with air. Bisulphide of carbon is a sulphur acid. The sulphur in gas is a pernicious thing, because it forms sulphurous acid by taking oxygen from the air when burning. It is therefore necessary to use lime for eliminating all the carbonic acid and part of the bisulphide of carbon. As to the sulphur compounds in the so-called bisulphide of carbon, their entire removal is undoubtedly one of the most important problems in connection with the purification of coal gas; and though considerable progress has been made in this respect during the past few years, there is not anything known at present that will take it out entirely. It is a sulphur acid, and hydrogenated sulphide of calcium is the only agent that will remove a part of it. This material is produced in the following way: There should be two purifiers charged with hydrate of lime. When the crude gas is turned into the lime purifiers, the material in the first vessel will eliminate from the gas all the carbonic acid, and part of the sulphuretted hydrogen, and the remainder will pass on to the second purifier, where the lime is converted into what the writer terms hydrogenated sulphide of calcium, which at the present time is the best known agent for absorbing bisulphide of carbon. There must be sufficient sulphuretted hydrogen left in the gas which passes on to the second lime purifier to keep the lime in this particular condition.

In the management of retorts, whether they are of iron or clay, it is of the utmost importance that the interior should be kept as free as possible from carbon incrustation, as, in addition to occupying space that should be available for the coal, it presents a non-conducting substance, which obstructs the passage of the heat from the furnace to the coals undergoing carbonization. This not only increases the expense of the fuel for the furnace and for labour, but offers great facilities for the destruction of the retorts. The gas should be drawn from the hydraulic main as quickly as possible, so as not to subject it to back-pressure, which brings about a deposit of carbon to the same extent as would a very high temperature without pressure. The back-pressure on high heats would cause the splitting up of condensable hydrocarbons into non-illuminants, which would have the effect of not only reducing the quantity of gas obtained, but also of lowering the illuminating power of the gas, causing a deposit of carbon on the interior surface of the retort, and obstructing the ascension-pipes. It is equally necessary that the light-giving power of the gas should not be destroyed by using too high heats, or the quantity of the gas reduced by slow distillation. In the carbonization of coal, the greatest care should be taken not to have the heats either too high or too low. The former would require the use of cannel to compensate for the loss of luminosity in the gas; with the latter there would be more tar and less gas, as well as soft coke, which is not profitable. The retorts should be kept at a bright red heat during the carbonization of the coals. For the greater part of the time the charge of coal is burning off, it remains without any elevation of temperature. Shortly after the coal is put into the retort and the lid closed, it commences to intumesce, and, delivering the gas, carries off the heat communicated from the furnace to the retort and then to the coal. The action is very similar to that of an ordinary kettle when the water is boiling. It delivers the heat absorbed by the water in the form of steam, which issues from the spout. Thus it is only when nearly all the volatile constituents or useful gases are passed off from the coal that the temperature of the mass of carbon increases. After the coke begins to form, and all the little pores which have served as passages for the egress of the gas during the carbonization process close, then the heat rises.

In the carbonization of coal, care should be taken that the

retorts are not overcharged. If they are filled too full, there will not be sufficient room for the coal to swell. If it touches the crown of the retort, it causes incrustation. A dense black fluid is formed at the moment of placing the lid of the retort on, which is nothing more than the volatile properties of the coal passing off as gas, tar, and other products—such as ammonia, hydrocarbons, and other constituents. Another precaution to be observed is to draw the coke as soon as it becomes incandescent. By retaining it in the retort after all the useful gas is given off, other gases are delivered, though in small quantities, which deteriorate materially that first obtained; and from these arise the sulphur compounds other than sulphuretted hydrogen which cause so much trouble. Bisulphide of carbon is generated principally in this way. If the heat is allowed to act upon the residual coke, the bisulphide will be given off, as the coke holds the protosulphuret of iron resulting from the decomposition of the bisulphide in the coal. The sulphur from the coke combines with sufficient carbon to form bisulphide of carbon.

By storing or passing through cold pipes, gas loses in illuminating power, owing, no doubt, to the condensation of naphthalene ($C_{10}H_8$), benzol ($C_6H_6$), and allied or derived substances. Moreover, as olefiant gas ($C_2H_4$) is soluble in water, this constituent, which is very serviceable for lighting purposes, is also diminished by storing the gas. It will now be understood why the gas has to be of higher illuminating power in the winter than in the summer. The relative proportions of permanent gas and condensable solids and liquids, as well as the chemical nature of these products, depend on the temperature employed in carbonizing the coal, and the length of time the material is exposed to the action of heat. The lower the temperature, and the more quickly the operation is carried out, the greater is the proportion of solid and liquid products, and *vice versâ*. The reason for this is that more complex substances generally split up into simpler ones on exposure to heat; and the higher the temperature, the simpler the product. Thus, olefiant gas ($C_2H_4$) will split up into light carburetted hydrogen; and the coke will give off sulphur, which will combine with carbon and give rise to bisulphide of carbon. Though it is the chief object of the distillation of coal to get a large yield of permanent gas, it is equally necessary that the illuminating value of that gas should not be destroyed by using too high a heat, and that an undue proportion of tar should not be produced by employing too slow a distillation, which is not profitable.

In carbonizing coal, do not separate the gas from the tar in the hydraulic main. Let both pass together to the condensers; and in the passage to and through these vessels the tar will take out of the gas some of its impurities before it reaches the scrubbers and purifiers. Good condensation helps greatly in the purification of coal gas. Anti-dips are scarcely of any good to a gas manager, and for this reason: The gas as it is made is passed directly away, without mixing with the tar when it is of high temperature in the hydraulic main. As the tar, as already remarked, is a purifying agent, the gas ought not to be separated from it in the hydraulic main. On examining the nature of tar, we see that it is composed of certain solid properties, such as carbon, naphthalene, &c.; while there are gaseous properties, such as hydrogen, carburetted hydrogen, carbonic acid, sulphide of carbon, &c. The writer nevertheless thinks that tar can certainly be treated as a purifying agent; for without it, or some similarly constituted substance, the purification of coal gas would be a failure. If there were not amalgamation of so many of the properties which crude gas contains as it passes into the hydraulic main, it would be almost impossible to rid it of its impurities. As the gas rises from the retorts and issues at the top of the ascension-pipes, it has a smoky appearance; but after it has passed through the tar in the hydraulic main, and traversed the condensers, it has lost this characteristic. This brings me back to my previous statement that tar is a purifying agent. Let us, then, not look upon it as an enemy, but as a good friend. As soot or solid carbon has no affinity for water or watery vapour —indeed, it repels it—what benefit is there in drawing off the tar, and having a water-seal, instead of passing the gas through the tar in the hydraulic main? The writer is of opinion that if the gas is allowed to go through the tar, and pass on with it to the condensers, it will remove the finely-divided particles of soot or carbon, and at the outlet of the condensers all the smoky colour of the crude gas will have been removed. By using anti-dips, the gas would lose the purifying it gets by passing through the tar. In working inclined retorts, it is well not to have a dry main, or one with a water-seal; for the reason that as soon as the coke begins to form the sulphur passes away with the gas. The formation of coke generally commences at the top end of the retort; and this coke holds the protosulphuret of iron, which, as previously stated, gives rise to bisulphide of carbon. When the driving off of the volatile constituents begins to slacken, this newly-formed coke gives off some of the sulphur compounds it contains. When the heat, after expelling the constituents of the coal, is made to act upon the newly-formed coke, bisulphide of carbon makes its appearance very fast. No one will deny that coke contains sulphur. By using the original dip-pipes, and a wet main, the gas, by passing through the tar, will lose some of its sulphur compounds. The writer's closing advice to young gas managers and gas students is: Do not have anti-dips if you can avoid it, especially if you have to work inclined retorts. If the hydraulic main is kept clear in the way indicated by the writer in preceding articles, there will be no need of anti-dips.

# TECHNICAL RECORD.

## PACIFIC COAST GAS ASSOCIATION.

### Annual Meeting at San Francisco.

(*Concluded from p.* 532.)

Mr. J. L. Howard, of San Francisco, read a paper on "Coal Combustion and Smoke Prevention," dealing with the properties of various kinds of coals as indicated by proximate analysis, the necessary proportion of oxygen to ensure complete combustion, and the fact that smoke consists of volatile matter given off and allowed to pass away, either without being exposed to a temperature sufficient to bring about its complete combustion, or without the admixture of a sufficient proportion of air to supply the necessary quantity of oxygen. In many American cities, anti-smoke regulations were in existence, but were not strictly enforced. He described the principles involved in the construction of smoke-preventing appliances, and said it was a mistake to suppose that because visible smoke represented a very trifling proportion of the total carbon contained in the fuel, complete combustion was not a commercial question. The visible carbon was usually accompanied by large quantities of carbon monoxide and other invisible products of incomplete combustion, which represented a considerable loss or waste of heat. In his experience, any bituminous coal could be consumed without production of smoke, if a self-feeding and clinkering arrangement was used, so as to avoid admission of cold air, and also if a large proportion of the air supply (about two-thirds) was admitted above the bed of fuel, and not from below.

Mr. Britton remarked that in many parts of the district liquid fuels were cheaper than solid. Using Coalinga oil by means of a steam-injector, he had avoided the production of smoke, and evaporated 17½ lbs. of water per pound of oil used. He spoke very highly of its advantages, as compared with solid fuels. The boilers were of the ordinary return tubular pattern, always in excellent condition, as he used water that had been proved by analysis to be the purest in the State. Mr. Jones thought the application of the regenerative principle to boiler furnaces would solve the smoke question. It was possible to waste a lot of heat, and yet not show visible smoke; and many of the members had done so when heating beds of threes with the old-fashioned grate furnace. The best practice in ordinary boiler firing was to keep the fuel in an even shallow bed. Mr. Martin said that the temperature of the products of combustion at the outlet-flue to the chimney should not exceed that of the water in the boiler by more than 70°. Much heat was lost by allowing the gases to pass away at too high a temperature.

A paper submitted by Mr. W. M. Parker, of New Whatcom (Washington), was read by the Secretary, in the absence of the author. The title was: "Should Gas Companies do all Gas-Fitting?" Inquiries as to the practice in this respect were submitted to 41 gas undertakings, and elicited 24 replies. These went to show that the usual practice is to run services and fix stoves, but to leave ordinary gas-fittings to local tradesmen—sometimes exercising indirect control over the work. The author favoured enterprise on the part of the gas company in this direction, and would put in fittings at cost price, if necessary, to make sure of a customer. Thirteen companies had furnished him with printed rules for the guidance of gas-fitters, as used in their respective districts. Various details in connection with gas-fitting work were next discussed at considerable length; and a model circular, embracing all the good features suggested by the information obtained, was submitted. The author related some of his experiences in connection with local gas-fitters, which had led him to believe that, in their own interest, the gas company should undertake the whole of the gas-fitting work up to the burner.

The Editor of the "Wrinkle" Department (Mr. Hollidge) next presented a very interesting report, a considerable proportion of which was contributed by himself. Mr. William Parker, the author of the paper already mentioned, also sent several interesting suggestions relating to the details of gas-fitting work. One for laying services in wooden troughs, and surrounding them with pitch, led to a long discussion on the effects of electrolysis; and several speakers described instances where these effects had been observed, when no electric power or supply was in the neighbourhood. These phenomena were observed in marshy, made-up ground, and were accounted for by a galvanic action in the ground itself, due to the presence of salt or other chemicals. The subject of electric lighters for Welsbach burners received a considerable amount of attention. One novel suggestion was that gas-fitters and service-layers should be supplied with white lead putty put up in artists' collapsible tubes. Speaking upon a scheme for lighting purifying houses by means of the electric glow lamp, Mr. Aldrich said that his religion would not allow him to use electric light of any kind on the gas-works; and he preferred to arrange matters so that the purifying-house work was all done in daylight.

The Question-Box was opened. An inquiry as to whether the reading of meter indices should be taught in public schools brought out a long discussion, the tone of which was to the effect that the more the public are taught about meters and their working the better the gas companies will be pleased. A full discussion on the advantages or otherwise of testing meters

*in situ* followed. The President made the remarkable statement that many meters which showed 14 or 20 per cent. slow in place, would prove correct when taken out and carried to the testing-room. He explained this by saying he had found that a sort of fine tarry dirt accumulated on the faces of the valves, forming some fine ridges that allowed the escape of a considerable quantity of gas. But during the act of conveying to the testing-room, the light oil which always accumulated on the floor on which the valves are bedded washed over the valves, and displaced some of the dirt, or at any rate lubricated them and made them tight. Mr. Osborne said that new meters worked stiff at the start, and were usually slow for a time. Mr. Britton remarked that in small towns it was possible to check the meter inspector; but in large places there was no check at all, and everything depended on the honesty of the inspector, where the system of house-to-house testing was followed. The preponderance of opinion was certainly in favour of testing meters in position. In a discussion on the preparation of oxide, Mr. Guldlin recommended a layer of pine shavings 15 inches thick, and about 3 inches thickness of fine cast-iron borings spread on the top, the whole to be well mixed and watered with salt water or sea water until oxidation was complete. If any unoxidized iron remained in the mass, when it was used, troublesome deposits of iron carbonyl would occur at the burners. Several members, however, preferred copperas reduced with lime, to the use of borings.

The meeting was brought to a close with the usual votes of thanks.

## GERMAN CHEMISTS IN CONCLAVE.

The intimate relation which subsists between the gas industry and modern chemical research was well illustrated by some of the communications made to the general meeting of the Association of German Chemists at Darmstadt this summer. Indirectly Professor Münch's lecture on Linde's process for the liquefaction of air was of interest to gas managers. Of the numerous experiments with which the lecture was illustrated, one—in which a limelight was supplied with vaporized liquid air in place of oxygen—demonstrated in a very practical manner the richness in oxygen of liquefied air. Linde has, indeed, devised a modification of his apparatus, by means of which the separation of oxygen from the atmosphere may be accomplished on a large scale. Dr. W. Staedel gave a brief account of acetylene. He lighted the lecture hall by means of five six-light wall-brackets supplied with acetylene from a cylinder of the liquefied gas. The illumination afforded by these thirty burners consuming acetylene, was better and more effective than that from four arc-lamp pendants with which the hall was ordinarily lighted. Dr. H. Bunte lectured on the "Theory of the Incandescent Gas Light," and illustrated his lecture by numerous experiments with mantles of varying composition. Our readers are already familiar with Dr. Bunte's views on the catalytic or contact action of cerium oxide in the Welsbach mantle from his earlier communications;* and he introduced no novel matter of importance to his Darmstadt audience. He expressed the opinion that the most promising direction for research in incandescent lighting was that in which the more recent improvements had been made—viz., in the production of better combustion of the gas and of a higher flame temperature. Many points in the theory of incandescent lighting still needed explanation; and he thought that a better knowledge of the action of the flame and mantle would furnish the means for further improvements.

## MARKS ASSOCIATION OF GAS AND WATER ENGINEERS.

The Nineteenth Annual Meeting of this Association was held from the 12th to the 14th of August, at Frankfort-on-the-Oder, and was attended by nearly 90 members and visitors. On the first day, the large works of Messrs. Julius Pintsch, at Fürstenwalde, were visited. The extensive use of water gas for various purposes, and the practical employment of the process of electric welding, were the features which specially attracted the attention of the visitors. On the 13th, an early morning visit was paid to the Frankfort works of the German Continental Gas Company. Herr W. Jäger, of the firm of Messrs. Pintsch, next presented an interesting communication on the "Manufacture and Use of Water Gas." Several subjects were discussed, after brief introductory addresses. Among these were "Machine-Stokers," of which those at the Salzwedel works were described by Herr Ludwig; "Naphthalene Stoppages," introduced by Herr Blum; and the "Import Duty on Petroleum," to which the members, on the motion of Herr Silbermann, resolved to direct the attention of the German Association of Gas and Water Engineers, with a view to presenting a petition to the Imperial Parliament praying for the exemption from duty of those petroleum products which are suitable for carburetting water gas. Purifiers, prepayment meters, automatic igniting devices, and water-meters were also briefly discussed. Herr Müller, of Charlottenburg, was re-elected President of the Association.

* See "JOURNAL," Vol. LXXI., pp. 398, 1570.

## THE CHEMICAL COMPOSITION AND TECHNICAL ANALYSIS OF WATER GAS.

By EDWARD H. EARNSHAW,

Chemist to the United Gas Improvement Company of Philadelphia, U.S.A.

[From the "Journal of the Franklin Institute," September, 1898.]

As is well known, water gas is a product of the reaction between steam and incandescent carbon, whereby there is formed a mixture of carbonic oxide and hydrogen in approximately equal volumes. This mixture, technically called "blue gas," has, of course, no illuminating value; and it is therefore enriched by exposing it, together with hydrocarbon vapours, to the action of intense heat. The hydrocarbon vapours are thus permanently gasified, or "fixed," and impart a high illuminating power to the mixture. This is carburetted water gas—more familiarly known simply as water gas.

The enriching material employed is always petroleum in some form—usually as crude oil, naphtha, or a distillate called gas oil—which during the "fixing" process is converted into hydrogen and gaseous hydrocarbons, together with naphthalene, benzene, and its homologues, and the other pungent empyreumatic compounds found in coal gas, and formed in that case by the contact of the gas with the hot sides of the retorts. The odour of coal gas is due to these empyreumatic compounds; and therefore, as might be expected, the odour of water gas is similar, but even more penetrating.

### *The Chemical Composition of Water Gas.*

The chemical composition of coal gas and water gas is essentially the same—that is to say, the same constituent gases enter into the composition of each mixture, but the relative proportions vary. This is illustrated by the following analyses of coal gas and water gas respectively. The figures given are of actual analyses, but are fairly representative of each class.

| | Coal Gas. Per Cent. | | Water Gas. Per Cent. |
|---|---|---|---|
| Benzene vapour | 0·50 | .. | 0·6 |
| Heavy hydrocarbons | 4·25 | .. | 12·8 |
| Carbonic oxide | 8·04 | .. | 30·7 |
| Hydrogen | 47·04 | .. | 32·4 |
| Marsh gas | 36·02 | .. | 13·9 |
| Higher paraffines | 0·00 | .. | 2·4 |
| Carbonic acid | 1·60 | .. | 2·7 |
| Oxygen | 0·39 | .. | 0·7 |
| Nitrogen | 2·16 | .. | 3·8 |
| | 100·00 | .. | 100·00 |

The composition of the heavy hydrocarbons, or "illuminants," varies greatly with circumstances, both with coal and water gas, though they always consist chiefly of ethylene and other members of the olefine series, together with small quantities of other hydrocarbons, of which acetylene is probably the most important.

From the gas analyst's point of view, the most important feature of the composition of water gas is the presence of notable quantities of paraffines other than marsh gas, since this involves a modification of the methods of analysis commonly in use, and which presuppose that marsh gas is the only paraffine present in the gas mixture. This is the point that I chiefly desire to bring to your attention.

### *The Analysis of Water Gas.*

The scheme of analysis, as far as the absorbable constituents of the gas mixture are concerned, follows the plan elaborated by Hempel, and is as follows:—

(1) The vapours of benzene are first absorbed by shaking the gas in an explosion pipette over mercury with 1 c.c. of alcohol, previously saturated for the less easily absorbable constituents. The vapour of alcohol is absorbed in another explosion pipette by 1 c.c. of water, and the resulting contraction measured.

(2) The carbon dioxide is absorbed by potassium hydrate in a pipette filled with small rolls of iron wire gauze.

(3) The heavy hydrocarbons or fixed illuminants are absorbed by a saturated aqueous solution of bromine. The vapours of bromine are absorbed by potassium hydrate, and the contraction measured. Fuming sulphuric acid may be used instead of bromine, but it is much more difficult and inconvenient to handle, and the results obtained are scarcely more accurate.

(4) Oxygen is absorbed by phosphorus. Some chemists urge the use of an alkaline solution of pyrogallic acid; claiming that the action of phosphorus is unreliable. I have found, however, that in every case where the phosphorus has failed to act, it has been due to incomplete absorption of the illuminants. Therefore, whenever on testing for oxygen, the white fumes of phosphoric acid fail to appear, the gas should be passed once more into the bromine solution. I have never yet analyzed a gas that did not contain at least a trace of oxygen. I strongly favour the use of phosphorus, because the results obtained are at least as accurate as with pyrogallol, and because the appearance of the white fumes is absolute proof of the presence of oxygen, and indicates as well that the illuminants have been completely absorbed.

(5) The carbonic oxide is now absorbed by an ammoniacal or hydrochloric acid solution of cuprous chloride.

At least two pipettes should be used for the absorption; the

last one containing a perfectly fresh solution. It is important to notice that even with this precaution the absorption of the carbonic oxide is seldom complete; usually about 0·5 per cent. remaining unabsorbed. This fact introduces no error in the analysis, as the residue of carbonic oxide can be determined later, as will be shown.

The residue of the gas mixture now remaining may be as follows:—

(a) $(H_2) + (CO) + (N_2) + (CH_4) + (C_2H_6) + (C_3H_8)$, &c.

But for all ordinary purposes it is sufficient to assume that the only higher paraffine present is $C_2H_6$.

There being no satisfactory known absorbent for any of these gases, it becomes necessary to have recourse to the method of combustion.

A portion of (a) is then mixed with a measured volume of air, and exploded over mercury in an explosion pipette. The contraction in volume is measured; the carbon dioxide formed is determined by absorption with potassium hydrate; the excess of oxygen is absorbed by phosphorus; and the volume of the residual nitrogen is noted.

The equations are—

(1) Contraction in volume $= \frac{3}{2}(H_2) + \frac{1}{2}(CO) + 2(CH_4) + 2\frac{1}{2}(C_2H_6)$

(2) $CO_2$ formed $= (CO) + (CH_4) + 2(C_2H_6)$

(3) Residual nitrogen $= (N_2) + (N_1)$,

where $N_1$ is the nitrogen introduced with the air. The amount of nitrogen thus introduced may, with sufficient accuracy, be taken at 79·2 per cent. of the measured volume of air.

An examination of these equations shows that the nitrogen may at once be ascertained from Equation 3; but Equations 1 and 2 contain four unknown quantities, and therefore two more equations are needed for the solution. Fortunately the method of fractional combustion over palladium affords the needed information. As is well known, when a mixture of hydrogen and methane with oxygen or air is passed, with the proper precaution, over heated palladium black, the hydrogen burns to water; but the methane is unaltered. If carbonic oxide and any of the higher paraffines are also present, the carbonic oxide burns; but the paraffines do not. If, then, the products from the combustion are received in a pipette over mercury, it is possible to subsequently measure the amount of carbonic acid formed by the burning of the carbonic oxide.

Returning to the analysis, a second portion of (a) is taken, mixed with air, and burned over palladium black. The resulting contraction and the carbonic acid formed are measured. The equations are—

(4) Contraction in volume $= \frac{3}{2}(H_2) + \frac{1}{2}(CO)$.

(5) $CO_2$ formed $= CO$.

From these two equations the values for hydrogen and carbonic oxide may be readily calculated.

For simplicity's sake let us now assume that the same quantity of gas mixture (a) was used in both the explosion and the combustion. We may then subtract Equation 4 from 1, and 5 from 2, whence, designating the difference between the contraction due to explosion and that due to combustion by the letter "a" and the difference in the carbonic acid formed by the letter "b," we find—

(6) $2(CH_4) + 2\frac{1}{2}(C_2H_6) = a$.

(7) $(CH_4) + 2(C_2H_6) = b$.

(8) whence $C_2H_6 = \frac{4b - 2a}{3}$

(9) $CH_4 = \frac{4a - 5b}{3}$.

A very useful check on the accuracy of this determination is obtained from the following:—

Volume of gas taken for explosion $= H_2 + N_2 + CO + CH_4 + C_2H_6$. $H_2$ and CO are found by Equations 4 and 5, and $N_2$ is given by Equation 3. Therefore we have—

(10) Volume taken $- (H_2 + N_2 + CO) = CH_4 + C_2H_6$; and this value should be the same as the algebraic sum of Equations 8 and 9; or—

(11) Volume taken $- (H_2 + N_2 + CO) = \frac{2a - b}{3}$.

This scheme of analysis is perfectly correct for gas mixtures containing no higher paraffine than $C_2H_6$; but what would happen in case $C_3H_8$, $C_4H_{10}$, &c., were present?

Our gas mixture would then contain P volumes of hydrocarbons of the formula $C_nH_{2n+2}$, and would be—

Gas mixture $= H_2 + N_2 + CO + P(C_nH_{2n+2})$.

As will be shown later, the contraction in volume due to the combustion of P volumes of any hydrocarbon of the general formula $C_nH_m$ would be

$$P\left(1 + \frac{m}{4}\right)$$

and the carbonic acid formed would be Pn. But in this case, $m = 2_{n+2}$; and therefore we have,

From the explosion:

(12) Contraction in volume

$$= \tfrac{3}{2}(H_2) + \tfrac{1}{2}(CO) + P + \frac{Pn + P}{2}$$

(13) Carbonic acid formed $= Pn + CO$.

And from the combustion over palladium:

(14) Contraction in volume $= \frac{3}{2}(H_2) + \frac{1}{2}(CO)$.

(15) Carbonic acid formed $= CO$.

Subtracting Equation 14 from 12 and 15 from 13, as before explained, we have,

(16) Difference in contraction

$$P + \frac{Pn + P}{2} = a$$

(17) Difference in carbonic acid formed $= Pn = b$; whence,

(18) $$P = \frac{2a - b}{3}$$

(19) $$n = \frac{3b}{2a - b}$$

Equation 18 is identical with Equation 11; and hence it appears that the method is correct as far as the total volume of paraffines is concerned, even though higher paraffines than $C_2H_6$ are present.

Having thus examined the theory of the analysis by combustion, let us follow the figures of an actual analysis.

The gas was a water gas, enriched by naphtha, and its candle power was 23·5.

Amount taken for analysis . . . . 100·0 c.c.

| | *Per cent.* |
|---|---|
| $C_2H_6$ absorbed by alcohol | 0·4 |
| $CO_2$ absorbed by potash | 2·7 |
| Illuminants absorbed by bromine | 11·7 |
| Oxygen absorbed by phosphorus | 0·5 |
| Carbonic oxide absorbed by cuprous chloride | 31·7 |

Of the unabsorbed residue of 53 c.c., 14·05 c.c. were mixed with 87·8 c.c. of air, and exploded by a spark in an explosion pipette over mercury. The resulting contraction in volume was 22·60 c.c. The carbonic acid absorbed by potash was 5·30 c.c.; the surplus oxygen absorbed by phosphorus, 3·80 c.c.; the residual nitrogen, 70·1 c.c. consisting of nitrogen from the air, 69·50 c.c. and nitrogen from the gas, 0·60 c.c.

A second portion of 30 c.c. was now mixed with 70 c.c. of air, and the mixture passed over palladium black to burn the hydrogen and carbonic oxide.

The contraction in volume was 30·40 c.c.

The carbonic acid absorbed by potash was 0·40 c.c.

To calculate the percentage of H, CO, $CH_4$, $C_2H_6$, and N according to the method already theoretically explained, we proceed thus—

$$CO = \frac{0{\cdot}4 \times 53}{30} = 0{\cdot}70 \text{ per cent.}$$

$$H = \frac{(30{\cdot}4 - 0{\cdot}2) \times 53}{30} \times \frac{2}{3} = 35{\cdot}57 \text{ per cent.}$$

Now, as 30 c.c. of gas were taken for the combustion and only 14·05 c.c. for the explosion, we must calculate the contraction in volume and amount of carbonic acid that would have resulted from the combustion of 14·05 c.c. over palladium. Thus—

Contraction in volume would be

$$= \frac{30{\cdot}4 \times 14{\cdot}05}{30} = 14{\cdot}24$$

$CO^2$ formed would be

$$= \frac{0{\cdot}40 \times 14{\cdot}05}{30} = 0{\cdot}18$$

Subtracting these figures from the results of the explosion, we find,

$$22{\cdot}60 - 14{\cdot}24 = 8{\cdot}36 = a$$
$$5{\cdot}30 - 0{\cdot}18 = 5{\cdot}12 = b$$

and hence, from Equations 8 and 9

$$C_2H_6 = \frac{20{\cdot}48 - 16{\cdot}72}{3} = 1{\cdot}25$$

$$CH_4 = \frac{33{\cdot}44 - 25{\cdot}60}{3} = 2{\cdot}61,$$

and therefore,

$C_2H_6$ in original gas

$$= \frac{1{\cdot}25 \times 53}{14{\cdot}05} = 4{\cdot}71 \text{ per cent.}$$

$CH_4$ in original gas

$$= \frac{2{\cdot}61 \times 53}{14{\cdot}05} = 9{\cdot}84 \text{ per cent.}$$

N in original gas

$$= \frac{0{\cdot}60 \times 53}{14{\cdot}05} = 2{\cdot}26 \text{ per cent.}$$

Applying Equation 11 as a check on the accuracy of the determination, we find—

$$14{\cdot}05 - (9{\cdot}43 + 0{\cdot}60 + 0{\cdot}18) = \frac{2\,(8{\cdot}36) - 5{\cdot}12}{3}$$

or, 3·84 = 3·86, which is a difference well within the limit of errors of observation.

In the calculation of this analysis we have assumed for convenience sake that there are no paraffines present other than $CH_4$ and $C_2H_6$. Of course, it is possible, and indeed probable, that higher members of the series are actually present; so that while the figures obtained in our calculations truly represent the total quantity of paraffines contained in the gas, yet they may not be true as regards the actual composition. The composition

of the average molecule of the paraffines may be obtained from Equation 19, thus—

$$n = \frac{15{\cdot}36}{16{\cdot}72 - 5{\cdot}12} = 1{\cdot}32$$

whence the average composition of the paraffines $C_nH_{2n+2}$ would be: C, 1·32; H, 4·64.

The value of this method in giving an accurate conception of the actual composition of a gas mixture, is clearly brought out by comparing the figures just given with those obtained by the more usual methods of calculation. These methods are: (1) When no combustion over palladium is made, and the hydrogen is determined by subtracting twice the volume of carbonic acid formed in the explosion from the contraction in volume, and calling the difference the contraction due to hydrogen. (2) The method recommended by Hempel, who directs that the hydrogen should be determined by combustion over palladium. The contraction in volume due to the percentage of hydrogen thus found, is subtracted from the total contraction due to the explosion, and the remainder is considered to be the contraction due to $CH_4$, which is, of course, equal to twice the volume of $CH_4$. Both these methods presuppose that no paraffine other than $CH_4$ is present, and that the carbonic oxide has been completely absorbed by cuprous chloride.

| | Calculated by Method Given Above. | By Method without Combustion over Palladium. | By Method according to Hempel. |
|---|---|---|---|
| Benzene vapours | 0·40 | 0·40 | 0·40 |
| Fixed illuminants | 11·70 | 11·70 | 11·70 |
| Carbonic oxide | 32·40 | 31·70 | 31·70 |
| Hydrogen | 35·57 | 30·34 | 35·84 |
| Paraffines $C_2H_6$ | 4·71 | — | — |
| Paraffines $CH_4$ | 9·84 | 20·00 | 16·30 |
| Carbonic acid | 2·70 | 2·70 | 2·70 |
| Oxygen | 0·50 | 0·50 | 0·50 |
| Nitrogen (by difference) | 2·18 | 2·66 | 0·86 |
| | 1000·00 | 100·00 | 100·00 |

The method without separate determination of hydrogen is the simplest both in method and in apparatus required, and is, therefore, the one in most general use.

In the analysis of water gas by this method, let us consider the equations resulting from the explosion of 15 c.c. of a gas mixture composed of—

| | |
|---|---|
| H | 10·0 c.c. |
| $CH_4$ | 3·0 |
| $C_2H_6$ | 1·5 |
| N | 0·5 |
| | 15·0 |

The resulting equations would be—

| | | |
|---|---|---|
| Contraction in volume | $= \frac{3}{2}(H_2) + 2(CH_4) + 2\frac{1}{2}(C_2H_6)$ | $= 24{\cdot}75$ |
| Carbonic acid formed | $= (CH_4) + 2(C_2H_6)$ | $= 6{\cdot}00$ |
| Volume of gas taken | $= H_2 + CH_4 + C_2H_6 + N_2$ | $= 15{\cdot}00$ |
| Nitrogen | $= N_2$ | $= 0{\cdot}50$ |

At first, it would seem that these equations could be easily solved, and that no more data would be required for the correct computation of the composition of the gas mixture. An attempt to solve the equations, however, discloses the fact that the problem is indeterminate, and that the equations can be satisfied by any value of $C_2H_6$ from 0 to 3. Thus—

| Let $C_2H_6$ = 0, | | Let $C_2H_6$ = 3, | |
|---|---|---|---|
| Then, $H_2$ | = 8·50 | Then, $H_2$ | = 11·50 |
| $CH_4$ | = 6·00 | $CH_4$ | = 0·00 |
| $C_2H_6$ | = 0·00 | $C_2H_6$ | = 3·00 |
| $N_2$ | = 0·50 | $N_2$ | = 0·50 |
| | 15·00 | | 15·00 |

We may perhaps find in this circumstance an explanation for the continued use of this method by many analysts without suspecting the incorrect application to gas mixtures containing higher paraffines than methane. The analysis would always "add up well," and the amount of nitrogen found would be correct.

I have now indicated a method by which we may obtain a very fair idea of the composition of a gas mixture—sufficient, indeed, for most purposes. But the use of gas as a source of heat is constantly increasing; and I believe the time is not far distant when the heating value of a gas will be considered as important as its illuminating power. It is therefore extremely desirable to be able to accurately calculate the heating value of a gas from its analysis. The labours of many able investigators (and notably those of Professor Julius Thomsen) have supplied us with reliable data concerning the heating value of each of the several combustible gases entering into the composition of illuminating gas; and therefore the problem would offer no special difficulty were it not for the uncertainty regarding the nature of the hydrocarbons removed by bromine, and classed together as "fixed illuminants." We know that these consist chiefly of the series $C_nH_{2n}$, together with very small quantities of the $C_nH_{2n-2}$ series; but the quantitative separation of the different members is not at present possible within the limits of a technical analysis.

If, however, we should succeed in determining the average composition of the hydrocarbons, and should be able to assign a definite heating value, depending upon such average composition, then the problem would be completely solved as far as its practical application is concerned.

The theory of the combustion of any hydrocarbon or mixture of hydrocarbons, of which the unit volume has the average composition $C_nH_m$, is as follows:—

$$C_nH_m\left(n + \frac{m}{4}\right)O_2 = n(CO_2) + \frac{m}{2}(H_2O)$$

But in practice the $\frac{m}{2}$ volumes of water disappear; and therefore we have—

Contraction in volume

$$= 1 + \left(n + \frac{m}{4}\right) - n = 1 + \frac{m}{4}$$

Carbonic acid formed $= n$

If we let a = contraction in volume for x volumes $C_nH_m$
b = $CO_2$ formed for x volumes $C_nH_m$ then we find,

(20) $$m = \frac{4(a - x)}{x}$$

(21) $$n = \frac{b}{x}$$

It is now apparent that if we can by any means determine the contraction in volume and the amount of carbonic acid that would be formed by the combustion of a known volume of the illuminants in a gas mixture, then we shall have all the data necessary for the correct computation of the average composition of such illuminants. This can be done very simply and accurately thus—

First absorb the unfixed vapours by alcohol, and the carbonic acid by potassium hydrate. The residual gas will have the composition—

$$C_nH_m + CO + H_2 + C_nH_{2n+2} + O_2 + N_2$$

Take a portion of this, mix it with the proper amount of air, and explode the mixture by a spark in the ordinary way. Note the resulting contraction in volume, and the amount of the carbonic acid formed.

The contraction in volume will consist of—

(1) Contraction due to $C_nH_m$,
(2) ,, ,, CO,
(3) ,, ,, $H_2$,
(4) ,, ,, $C_nH_{2n+2}$,

and the carbonic acid formed will consist in like manner—

(1) $CO_2$ due to $C_nH_m$.
(2) ,, ,, CO,
(3) ,, ,, $C_nH_{2n+2}$.

If, now, we proceed with the analysis, and determine the percentage of each constituent by the method already described, we shall be able to calculate the contraction due to CO, $H_2$, and $C_nH_{2n+2}$, and the $CO_2$ due to CO and $C_nH_{2n+2}$. This will give us the contraction in volume and the $CO_2$ due to $C_nH_m$ alone, and hence the data required.

In practice, it is simpler to calculate the correction for the paraffines and hydrogen directly from the results of the explosion rather than from the percentages of these gases; but this will be made plainer by considering the actual figures of an analysis.

Taking for illustration the same sample of water gas as before, the notes of the analysis would be:—

| | Cubic Centimetres. | Per Cent. |
|---|---|---|
| Amount taken for analysis | 100·00 | |
| Residue after absorbing the unfixed vapours and the carbonic acid | 96·90 (a) | |
| *First Explosion.* | | |
| Portion of (a) taken | 12·00 | |
| Mixed with 87·8 cubic centimetres of air and exploded: | | |
| Resulting contraction in volume | 16·05 | |
| Carbonic acid absorbed by potash | 10·55 | |
| Excess oxygen absorbed by phosphorus | 3·40 | |
| Residue from (a) | 84·90 | |
| Fixed illuminants absorbed by bromine | 10·25 | = 11·70 |
| Oxygen absorbed by phosphorus | 0·44 | = 0·50 |
| Carbonic oxide absorbed by cuprous chloride | 27·78 | = 31·70 |
| Residue (b) | 46·45 | = 53·00 |
| *Second Explosion.* | | |
| Portion of (b) taken | 14·05 | |
| Mixed with 87·8 cubic centimetres of air and exploded: | | |
| Resulting contraction in volume | 22·60 | |
| Carbonic acid absorbed by potash | 5·30 | |
| Excess oxygen absorbed by phosphorus | 3·80 | |

The amount taken for the first explosion was $\frac{12}{96{\cdot}9} = {\cdot}1237$ of the original quantity; and we can, therefore, calculate that it was composed of—

| | Per Cent. | | Cubic Centimetres. |
|---|---|---|---|
| Fixed illuminants | 11·70 × ·1237 | .. | 1·45 |
| Oxygen | 0·50 × ,, | .. | 0·06 |
| Carbonic oxide | 31·70 × ,, | .. | 3·93 |
| Residue (b) | 53·00 × ,, | .. | 6·56 |
| | | | 12·00 |

The contraction and carbonic acid resulting from the explosion of 14·05 cubic centimetres of residue (b) having been determined by the second explosion, we can, of course, readily calculate the results due to the combustion of 6·56 cubic centimetres.

The results of the first explosion can now be tabulated thus—

| | | | Carbonic Acid Contraction. Cubic Centimetres. |
|---|---|---|---|
| 1·45 | cubic centimetres of fixed illuminants ($C_nH_m$) gives | . | 4·15 .. 3·56 |
| 3·93 | ,, ,, carbonic oxide | ,, . | 3·93 .. 1·96 |
| 6·56 | ,, ,, residue (b) | ,, . | 2·47 .. 10·53 |
| | | | 10·55 .. 16·05 |

and hence from Equations 20 and 21,

$$m = \frac{4\,(3{\cdot}56 - 1{\cdot}45)}{1{\cdot}45} = 5\,82$$

$$n = \frac{4{\cdot}15}{1{\cdot}45} = 2{\cdot}86$$

and, therefore, the average composition of the fixed illuminants $C_nH_m$ is: C, 2·86; H, 5·82.

Professor Julius Thomsen in his "Thermo-Chemical Investigations," Vol. IV., p. 275, gives the general formula for the calculation of the heat of combustion of any hydrocarbon of the formula $C_nH_{2m}$, expressed in calories per molecular weight in grams of the hydrocarbon, thus:—

$$f = n\ {\cdot}135340 + m\ {\cdot}37780 - a\ {\cdot}14200 + 580.$$

For the olefine series, $C_nH_{2n}$,

$$n = m$$
$$a = n - 1$$

and, therefore, translating the formula into English units, we find for the heat of combustion of any hydrocarbon, or mixture of hydrocarbons of the general formula $C_nH_{2n}$

$$\text{B.T.U. per cubic foot} = n\ (757) + 70$$

$$\text{B.T.U. per pound} = 20432 + \frac{1900}{n}$$

For the paraffine series, $C_nH_{2n+2}$,

$$m = n + 1$$
$$a = n - 1$$

and, therefore, we find for the heat of combustion—

$$\text{B.T.U. per cubic foot} = n\ (757) + 251$$

$$\text{B.T.U. per pound } 20432 + \frac{53744}{14n + 2}$$

We found the composition of the illuminants to be $C_{2\cdot86}H_{5\cdot82}$; and this approaches so closely to the composition of olefines, that for all practical purposes we may consider the fixed illuminants as belonging entirely to that series.

Therefore, calculating the average heating value of the illuminants from the formula for the olefines, we have—

Illuminants, $C_{2\cdot86}H_{5\ 72} = 2235$ B.T.U. per cubic foot.

We found the average composition of the paraffines to be $C_{1\ 82}H_{4\cdot64}$; and hence from the formula for the paraffines, the average heating value would be:—

Paraffines, $C_{1\cdot82}H_{4\cdot64} = 1250$ B.T.U. per cubic foot.

We have shown that the determination of the total amount of paraffines in a gas mixture is not affected by considering $CH_4$ and $C_2H_6$ to be the only two members of the series present; and it is also true that the calculation of the heating value is unaltered by the same assumption. This may be shown thus:

The percentage of paraffines present and their composition, was found by the analysis to be—

14·55 p. c. $C_{1\cdot82}H_{4\cdot64} = 4{\cdot}71$ p. c. $C_2H_6 + 9{\cdot}84$ p. c. $CH_4$.

The calculation of the heating value would be—

| | | | | | |
|---|---|---|---|---|---|
| 0·1455 | cubic foot | $C_{1\cdot32}H_{4\cdot64}$ | × 1250 | = 182 9 | B.T.U. |
| 0·0471 | ,, ,, | $C_2H_6$ | × 1764·4 = 83·1 | } 182·3 | B.T.U. |
| 0·0984 | ,, ,, | $CH_4$ | × 1009 = 99·2 | | |

Thus the result is the same with each method of calculation.

The heating values obtained by Professor Julius Thomsen for the principal constituents of illuminating gas are given in the following table. Thomsen's original figures are given in calories per molecular weight of the substance in grams; and I have translated these into English units per cubic foot. The temperature of the products of combustion is assumed to be reduced to 18° C. or 64·4° Fahr.

| Name. | Molecular Formula. | Calories per Molecular Weight in Grams. | B.T.U.'s per Cubic Foot at 60° and 30″. |
|---|---|---|---|
| Hydrogen . . . | $H_2$ | 68,360 | 326·2 |
| Carbonic oxide . . | CO | 67,960 | 323·5 |
| Methane . . . . | $CH_4$ | 211,930 | 1009·0 |
| Ethane . . . . | $C_2H_6$ | 370,440 | 1764·4 |
| Propane . . . . | $C_3H_8$ | 529,210 | 2521·0 |
| Butane . . . . | $C_4H_{10}$ | 687,190 | 3274·0 |
| Ethylene. . . . | $C_2H_4$ | 333,350 | 1588·0 |
| Propylene . . . | $C_3H_6$ | 492,740 | 2347·2 |
| Butylene . . . . | $C_4H_8$ | 650,620 | 3099·2 |
| Acetylene . . . | $C_2H_2$ | 310,050 | 1476·7 |
| Benzene . . . . | $C_6H_6$ | 799,350 | 3807·4 |

Returning once more to our analysis, the calculation of the heating value of 1 cubic foot of the water gas would be:—

| | | | | |
|---|---|---|---|---|
| 0·0040 | cubic foot | $C_6H_6 \times 3807{\cdot}4$ . . . . | = 15·2 | B.T.U. |
| 0·0170 | ,, ,, | $C_{2\cdot86}H_{5\cdot72} \times 2235$. . . . | = 261·5 | ,, |
| 0·3240 | ,, ,, | $CO \times 323{\cdot}5$ . . . . . | = 104·8 | ,, |
| 0·3557 | ,, ,, | $H_2 \times 326{\cdot}2$ . . . . . | = 116·0 | ,, |
| 0·0471 | ,, ,, | $C_2H_6 \times 1764{\cdot}4$ . . . . | = 83·1 | ,, |
| 0·0984 | ,, ,, | $CH_4 \times 1009{\cdot}0$ . . . . | = 99·2 | ,, |
| 0·0538 | ,, ,, | $CO_2 + O_2 + N_2$ . . . . | = 0·0 | ,, |
| 1·0000 | | | 679·8 | ,, |

## THE USE OF COKE BREEZE IN SEWAGE PURIFICATION.

At the Meeting of the Western (U.S.A.) Society of Engineers a short time since, a paper on the above subject was contributed by Mr. J. W. ALVARD. The portion dealing with the results obtained by the use of coke breeze for sewage purification purposes in England and in Massachusetts was given in a recent number of "Progressive Age," from which the following particulars are extracted.

When Mr. W. J. Dibdin held the position of Chemist to the London County Council, he constructed in 1891 four experimental filters filled respectively with pea ballast, coke breeze, burnt clay, very coarse sand, and polarite (a proprietary article). These filters were worked intermittently for six weeks at average rates of 411,000 gallons per acre per day; the amount of purification effected being indicated by the reduction in oxidizable organic matter in solution as follows:—

| | |
|---|---|
| Burnt ballast . . . . . | 43·3 per cent. |
| Sand . . . . . | 46·6 ,, |
| Pea ballast . . . . . | 52·3 ,, |
| Polarite . . . . . | 61 6 ,, |
| Coke breeze . . . . . | 62·2 ,, |

In his report made at that time, Mr. Dibdin said: "From the results obtained, it appears that a considerable amount of purification could be effected by any filtering material, the *desiderata* evidently being porosity and consequent power of reabsorbing atmospheric oxygen. For foul waters, sand appears too fine; while the burnt ballast used was too coarse. Coke breeze seemed to unite the necessary qualifications; and as it was also a cheap material, it was selected for further trials on a larger scale."

In the second experiment, a full acre filter was constructed at the Crossness outfall of the London main drainage system. The ground was levelled, underdrained, and filled with 3 feet of coke breeze. The sewage was made to flow on to the bed to the level of the surface as quickly as possible, allowed to remain standing full for quite an hour, and then drawn off with the least delay. Working in this way, the filter passed 1½ million gallons (Imperial) a day for six days, resting one day. The purification obtained was 78 per cent., based on the oxidizable matter; and the filtrates were said to be clean and sweet.

At Sutton, a series of preliminary experiments were undertaken on a more elaborate scale, but with approximately similar results. Upon them as a basis, a coarse-grain filter was constructed by filling one of the precipitation tanks, previously used for the chemical process, with burnt clay. The sewage passed from thence into a second tank filled with coke breeze. The operation of this plant commenced on Feb. 11, 1897; and a rate of flow of 773,000 gallons per acre per day was obtained—the rest period included. The results of 76 days' operation in the first tank gave a reduction of 66 per cent. in the oxidizable matter; the effluent from the entire plant showing a total reduction of 86·5 per cent. in the oxidizable matter.

The solid matters held in suspension were reduced by the first tank 95 per cent., and by the combined operation 99·6 per cent. The total quantity of suspended solid matters in the sewage, which were disposed of by the bacteria, was equal to 77 tons of sludge removed during the time of treatment; the average sewage having contained 54½ grains per gallon. The fact that this quantity disappeared without causing nuisance is striking evidence of the capability of the process. At times these filters were worked up to a rate of nearly 3 million gallons of sewage per acre per day. Such high rates checked the bacterial action, but did not permanently disable the filters.

At Exeter, coke breeze filters 5 feet in depth on a similar plan have been in use since August, 1896, receiving sewage effluent much more concentrated than average American sewage. The rate of flow is about 666,000 gallons (Imperial) per acre per day, inclusive of rest periods; and the purification obtained is 75 per cent. in oxidizable matter removed.

In all of these biological filters, the operation is essentially different from ordinary sand filters or intermittent filtration as now practised. Indeed, these biological filters are not filters at all in the sense in which the word is ordinarily used. Mr. Dibdin calls them "bacteria tanks." Another sanitarian proposes the name "digestors." "Respirators" and "aspirators" have also been proposed. The term "biological filters" is not perhaps inappropriate, though the word "filter" is not apt. In these so-called biological filters then the tank is filled with sewage, preferably from the top. It stands full while the bacterial action takes place, and is then emptied as quickly as possible. This is the breathing action. In emptying, the air must of necessity follow down into every part of the mass of the filter, and complete the chemical action of oxidation. No other power is necessary to properly force the oxygen into the filter when the grain is sufficiently coarse. The biological action taking place on the surface of the grain, it follows that the greater this surface the larger the field for action; but as the ordinary suspended matter in the sewage should not be allowed to clog the interstices, a size ranging from peas to chestnuts, dependent upon the amount of suspended matter carried in the sewage, should be selected.

The character of the grain is essential; and that material which will the most readily occlude the atmospheric oxygen is

preferred. A rough porous surface is better than a smooth one, such as wave-worn gravel. Coke has the quality in a high degree, although slag, cinder, and coal are not far behind.

Coke breeze, being cheap and easily obtained, seems to have advantages. Though the selection of the material must be a question of local economy, it is evident that with a material of inferior efficiency a greater quantity and longer contact are necessary to make it economically equal to materials of the first rank.

Coke has the advantage that its porous structure holds large quantities of air in the interior of the grain. Experiments made by the writer show that immersion for a considerable time fails to fill the interior of the grain with liquid. A 24-hour immersion will result in wetting the surface only to the depth of $\frac{1}{8}$ inch; leaving the air in the interior in place. There is, therefore, a double surface of oxidation to act upon the sewage in the coarser grains, which cannot fail to add greatly to the efficiency of coke for this purpose.

Coke as a filtering material is not new to sewage-purification works; but, so far as the writer is aware, it has never been used as a true biological filter until recently. At Chiswick, coke filter-beds were used to screen the effluent from chemical precipitation by an upward flow through beds 160 feet long, 8 to 10 feet wide, and 2 feet deep. About 2½ million gallons of effluent daily were passed through these beds by continuous flow. After three months' use, the coke was removed, and burned under the boilers, creating very offensive odours, which contributed to the disuse of the filters. These works were installed in 1879.

At Sheffield, coke-breeze screens were installed in 1886 to filter the effluent from chemical precipitation. The estimated flow was about 10 million gallons of sewage daily. The effluent passed into filter-tanks, of which there were two for each precipitation tank. The filters were 5 feet in depth, and were so constructed that intermittent filtration could take place if desired; but no data can be found as to the rate of flow. The effluent from the filters was regarded as satisfactory. At Bradford and Leeds there are similar works, where the effluent from chemical precipitation is screened through coke breeze.

The continuous use of filters does not permit of biological action; the filters act as mechanical screens. Nevertheless some result is obtained; the quantity of organic matter held in solution by the effluent being reduced about one-fifth, while the mineral matters are reduced about four-fifths.

At Reading (Pa.), there has been in use a coke screen so arranged that the sewage is passed downward through a layer 1 foot thick held upon a wire mesh. About 1,250,000 gallons per day are passed through this screen at the rate of 4000 gallons per square foot per day, and with a reduction, as stated by the Secretary of the Pennsylvania State Board of Health, of about 40 per cent. of oxidizable matter. About 8000 lbs. of coke are used per week to charge the screen; and the removed coke is first dried in an oven and then burnt under the boilers. A visit to this plant showed that the screen was but a mechanical apparatus for retaining solid matters from the sewage in the most ordinary way, and that its use was offensive. The odour from the burning coke was such as would probably cause the discontinuance of the use of the screen at an early date.

From these brief descriptions of coke breeze in purification works, it is evident that all the use which had been made of this material previous to 1891 had been as a mechanical screen, and without reference to its peculiar adaptability as a biological filtration material. The commencement of its use as a true biological filter at Crossness in 1891 has been already noticed; and it only remains to study the experiments made with it by the Massachusetts State Board of Health.

Filter No. 65, filled with coke breeze, was operated at the rate of about 300,000 gallons per acre per day, with a removal of 96 to 99½ per cent. of impurities (measured by albuminoid and bacteria); and it is stated that "the filter has disposed of the applied sewage easily, and its effluent has been of a satisfactory quality." No mention is made in the report of trials at higher rates of flow with a smaller percentage of purification, which would be of great interest in view of the London, Exeter, and Sutton results. Filter No. 81 was also a coarse-grain filter, with cinders as a filtering medium, and was operated by filling and emptying as before described. The sewage run into this filter was ordinary Lawrence sewage strained through coke. The report says: "The filter received sewage at the rate of 514,000 to 610,000 gallons per acre per day, with a purification of from 50 to 75½ per cent.; the results showing less favourably for the cinder than for the coke." Filter No. 22 A, of coke breeze, 60 feet deep, was operated at the rate of 600,000 gallons per acre per day, with a purification of 65½ to 86 per cent. This was with crude Lawrence sewage.

In the general conclusion upon these experiments, the report states: "When coke breeze can be obtained, and the sewage given a preliminary treatment before sand filtration by being passed through this breeze at a high rate in gallons per acre per day, the organic matters in the sewage can be removed from the entire body of the sewage as completely as chemical precipitation removes them from the main body of the sewage."

The Massachusetts experiments do not seem to have produced as high results in rate of flow as the English experiments. The following tables give the results of experiments with coarse-grain filters at the Lawrence experimental station. The depth of breeze was 5 feet in each case; the rates of flow being 279,000 and 300,000 gallons per acre respectively.

| Entire Year of 1896. | Free Ammonia. | Albuminoid Ammonia. | Nitrogen as Nitrites. | Nitrogen as Nitrates. | Oxygen Consumed. | Bacteria per Cubic Centimetre. |
|---|---|---|---|---|---|---|
| Strained sewage . . | 4·07 | 0·41 | .. | .. | 2·12 | 1,500,000 |
| Effluent . . . . | 0·51 | 0·38 | 2·49 | 0·204 | 0·15 | 11,127 |
| Purification, per cent. | 0·875 | 0·905 | .. | .. | 0·93 | 0·995 |

| Based on the last Five Months of 1896. | Free Ammonia. | Albuminoid Ammonia. | Oxygen Consumed. | Bacteria per Cubic Centimetre. |
|---|---|---|---|---|
| Strained sewage . . | 4·084 | 0·440 | 2·21 | 1,605,800 |
| Effluent . . . . . | 0·266 | 0·0366 | 0 15 | 6,552 |
| Purification, per cent. | .. | 0·965 | 0·93 | 0·999 |

The following table gives the results, in grains per gallon, of analyses made by Mr. Dibdin at Crossness on the efficiency of a coke-breeze filter 3 feet deep and covering an acre of ground. They extended over a period ranging from April 1, 1894, to Sept. 28, 1895:—

| Effluent Passed Daily per Acre. | Average Oxygen Absorbed in Four Hours. | | Average Albuminoid Ammonia. | | Average Nitrogen as Nitrates. | | Average Purification, as Determined by Oxygen Absorbed. |
|---|---|---|---|---|---|---|---|
| Galls. | (a) | (b) | (a) | (b) | (a) | (b) | Per Ct. |
| 500,000 | 4·096 | 0·856 | 0·416 | 0·095 | 0·1280 | 0·2378 | 0·793 |
| 600,000 | 3·608 | 0·730 | 0·396 | 0·113 | 0·0223 | 0 1414 | 0·796 |
| 1,000,000 | 4·113 | 0·935 | 0·382 | 0·114 | 0·3956 | 0·6990 | 0·775 |
| 1,000,000 | 3·512 | 0·884 | 0·360 | 0·102 | 0 1431 | 0·770 | 0·754 |
| 1,000,000 | 3·233 | 0·638 | .. | .. | .. | .. | 0·807 |

(a) Effluent. (b) Filtrate.

It has been suggested that, in the English experiments, effluents from precipitation or septic tanks were used; while in the recent Lawrence experiments the sewage was only mechanically screened. That effluents from chemical precipitation are much more easily oxidized than are the suspended matters of crude sewage is well known. Precipitants, as ordinarily used, not only settle the suspended matters, but partially dissolve them, so that they are more readily broken up by other processes. It will be observed that in the Massachusetts experiments crude Lawrence sewage was used upon a coarse-grain filter with comparatively as good results as with the screen sewage; while among the English results is one at Sutton, where not only is crude sewage, but a particularly concentrated sewage, run immediately upon coarse-grain filters.

The following table shows the quantity of suspended matter, in grains per gallon, removed by the English coke-breeze filters, according to results obtained by Mr. Dibdin:—

| Place. | Time of Operation. | Crude Sewage. | After Chemical Precipitation or Septic Process. | After Rough Filtration. | Final Effluent. |
|---|---|---|---|---|---|
| Crossness . . . | Four years | 31·0 | 6·3 | .. | Trace. |
| Exeter . . . . | Ten months | 24·5 | 10·8 | .. | Trace. |
| Sutton . . . . | Six months | 60·0 | .. | 2·78 | 0·75 |

In view of these results, we must believe that the English practice is wholly wrong, or that lack of experiment at Lawrence of high rates of flow for a long time are wanting. The latter supposition seems to be the most reasonable.

In the course of the discussion upon the paper, one of the members asked if there was any peculiar property in coke beyond its porosity and sharp corners—the porosity retaining the air, and the sharp corners being the points upon which the suspended matter might cling; and whether any other material possessing the same mechanical qualities would not answer the purpose. Another member pointed out to the questioner that the great advantage of coke was that it absorbed the oxygen, and that the sewage, when admitted to the tank, confined the air in the coke; giving two surfaces on which the oxygen acted. The same was true of any corresponding porous material.

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It may be remembered that, in the course of his Inaugural Address at the recent annual meeting of the Society of Chemical Industry, noticed in the "JOURNAL" for July 19 (p. 151), the subject dealt with in Mr. Alvard's paper was mentioned by Dr. Frank Clowes. He said: "Those who are interested or concerned in the disposal of our town sewage will watch with interest the development in recent years of the process of treating sewage by artificial filtration through coke or other suitable substances. This filtration is known to secure the oxidation of the putrescible matter of the sewage indirectly through the intervention of bacteria. Perhaps the nearest parallel cases are the change of sugar into alcohol and carbon

dioxide under the influence of the yeast cell; followed by the production of vinegar from the alcohol of malt liquor or 'must,' under the influence of the *mycoderma aceti*, which has long been known to be the organism necessary to transfer the atmospheric oxygen to the alcohol. Indeed, just as it is found necessary that the saccharine liquid shall be sown with the yeast cells, and the alcoholic liquid shall become sown with the *mycoderma*, before alcoholic fermentation and acetification can take place with rapidity, so it is found that the bacterial filter for sewage must become infected with the bacteria necessary for the liquefaction of the suspended organic matter of the sewage, and with those suited to effect the oxidation of the dissolved organic substances, before it is in a condition to purify the sewage. In experiments conducted on the small scale, a double filtration of raw London sewage through two small coke bacterial filters has in this way effected upon the raw sewage a purification of 95 per cent. It is hoped and anticipated that experimental filters of a similar kind, but on a larger scale, which are now being started, may produce a similarly successful result, and that their action may be continuous and permanent."

**Societe Technique du Gaz en France.**—We have received the volume of Transactions of this Society for the present year. It contains the report of the proceedings at the 25th annual congress, held at Nice from the 20th to the 22nd of April, under the presidency of M. Ph. Delahaye. Most of the technical matter, which is illustrated by four folding plates, has been already noticed in the "JOURNAL;" and the rest of the contents consists, as usual, of the rules, &c., and M. Victor Delahaye's review of the legal proceedings connected with the gas industry in the year 1896-7. Accompanying the volume is a useful index to the "Proceedings" of the Society from the commencement.

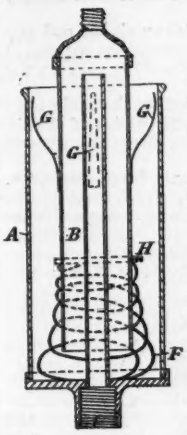
**Improved Anti-Vibration Fittings for Incandescent Burners.**—The use of special fittings to protect the mantles of incandescent gas-burners from the damaging effects of vibration is still necessary; and renewed activity in the production of these appliances is reported by Messrs. Clay and Walmsley, of Bolton. The firm have effected considerable improvement in their coiled-pipes anti-vibrator, and have also in preparation an entirely new form of anti-vibrator called the "cantilever," in which the coil is absent. Mr. Clay's latest invention is his "Floating Bunsen Anti-Vibrator," in which the use of any tube whatever is abolished. In the new anti-vibrator, the bunsen portion of the burner is entirely disconnected from the gas-supply pipe. Mr. Clay is also preparing a floating bunsen incandescent high-power gas-burner on the same lines. We hope to be able to give further particulars of these inventions in an early issue of the "JOURNAL."

**American Gaslight Association.**—The annual meeting of this Association will be held at Niagara Falls (N.Y.), from the 19th to the 21st prox., under the presidency of Mr. J. B. Crockett, of San Francisco. According to the official notice by the Secretary (Mr. A. E. Forstall), which appears in the "American Gaslight Journal," the following papers will be read: "The Effect of the Depth of Fire upon the Practical Efficiency of a Water-Gas Generator," by Mr. J. M. Rusby, of Jersey City; "Notes on Mains and Main Laying," by Mr. Walton Forstall, of Philadelphia; "The Loss of Illuminating Power of 25 to 30 Candle Gas when Mixed with Air," by Dr. E. G. Love, of New York; and "A Comparison between the Cost of Pumping Gas by Steam and Gas Engines," by Mr. H. L. Rice, of Norfolk (Va.). Papers are expected from Mr. I. Butterworth, of Columbus (Ohio), and Mr. E. C. Jones, of San Francisco; and short topics for discussion will be introduced by Mr. H. L. Doherty, of Madison, and Mr. E. G. Cowdery, of Milwaukee. The business proceedings will be accompanied by the usual social functions, which are always such pleasant features of these gatherings.

**Steel Riveted Water-Pipes.**—The President of the American Society of Civil Engineers, in the course of his recent address to the members, called attention to the fact that steel riveted pipes, for the conveyance of water from the source of supply to the point of consumption, have of late been introduced more liberally in the East. For long distances, with large diameters, under heavy water pressure, especially when few connections have to be used on the way, these pipes, he maintained, are as much superior to cast-iron pipes as the steel substitute is to the old cast-iron tension member of a bridge; and it is not doubted that they will be ultimately used to the exclusion of others. But, unfortunately, though similar pipes made of wrought iron have been successfully used for years on the Pacific coast and elsewhere, it cannot be said that the coatings used to preserve the metal from oxidation are entirely satisfactory. The rivets used for fastening the pipes and the lapping joints impede the flow to a certain extent; and a pipe has been devised, the fastenings of which are entirely outside and provide the pipe with a smooth bore. The great improvement in steel-welded pipes of large diameter will also remedy this defect to a large extent. An order is reported of several thousand tons of welded pipes to be made of Siemens-Martin mild steel, 24 feet long and 42 inches diameter, for the Birmingham Corporation Water-Works. The possibilities of steel pipes are also well illustrated by the proposition to convey a much-needed supply of water (of 5 million gallons per day) to a mining district of Western Australia, by means of a pipe 30 inches diameter and 328 miles long. This is evidently the scheme referred to in our last issue, p. 659.

## REGISTER OF PATENTS.

**Anti-Vibration Appliances for Incandescent Gas-Burners.**—Peach, C.; a communication from A. Vaughan, of Sydney, Australia. No. 20,524; Sept. 7, 1897.



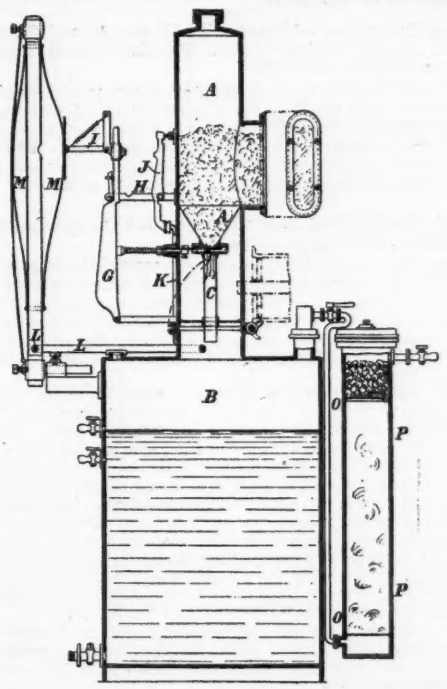

This is a modification of the same inventor's English patent No. 29,553 of 1896; and it consists of "a novel method of supporting incandescent gas-burners by means of springs within a luting cup." To effect this, there is connected to the tube or cup A the gas supply-pipe of the lamp. Inside is placed the spring F. Then on the intermediate tube B is adjusted the moveable sleeve H, by means of a set-screw, so that the lower portion of B does not rest on the bottom cup A. Springs G are also fixed on B, and thus communication between the tubes A and B, except by the springs G and F, is prevented. The tube A is filled with luting materials—water, glycerine, oil, mercury, or any other suitable fluid, or combination of fluids—which will flow up the tube B, and form a gas-tight seal, thus preventing the gas escaping from the central tube. A further effect of the luting material is that it will partly support the tube B, and at the same time form around it a cushion which will "retard vibration being communicated to the inner portions of the fitting."

**Mantles for Incandescent Gas-Burners.**—Gomess, A. F. B., of South Kensington. No. 22,327; Sept. 29, 1897.

To overcome the brittleness of collodion-covered mantles, the patentee proposes—after the mantle has been prepared for rendering it incandescent—to coat the fabric of ash with a weak solution of guttapercha, india-rubber, or similar gum, and over this coating to apply the collodion. According to the second way of carrying out the invention, which the patentee prefers, he treats the finished mantle—*i.e.*, after it has been stiffened as at present—by applying the "gum" over the collodion. The most convenient way of doing so is to immerse the mantle in the required solution and then dry it, repeating the operation, if necessary, until it is found that a sufficiently thick coating has been formed. The patentee mentions the proposal contained in patent No. 11,195 of 1887—to coat mantles with a solution of caoutchouc or with collodion—and he therefore lays no claim to either of these coatings separately; but what he claims is: "In incandescent mantles, the use of guttapercha, india-rubber, or similar gums, in combination with collodion, for the purpose set forth."

**Producing Acetylene Gas.**—Guy, C., of Ivry-la-Bataille, France No. 24,707; Oct. 25, 1897.

In this arrangement of plant, the carbide, powdered or divided into small fragments, is placed in a receptacle A, into which it is admitted through an orifice at top closed by a lid or plug. In the lower part of A (terminating in a cone), there is arranged the distributor through whose agency the carbide is enabled to drop into the water through a channel C. The lower part of it is closed by a plate provided with a rectangular aperture, below which moves a sliding door, in which is an opening. Below the slide there is a stationary plate provided with an opening similar to that of the slide, so that the slide-valve is comprised between the two plates. The slide is connected with a rod which, under




the action of a spring, presses with its other end upon an arm G, extending perpendicularly. This arm, at a certain point of its length, is guided by a slide H; its upper part being sustained by a spring, so that it is maintained in a practically perpendicular position, while it is also jointed to a lever I, to the end of which there is secured perpendicularly another plate. Upon the slide H, there is likewise arranged a lever J,

provided at its bottom part with a plug that closes the orifice of a tube K, communicating with the reservoir B, while its upper end is subjected to the action of a spring, which ensures the closing of the orifice of the pipe. The lever J carries a stop adapted to come into contact with another stop of the lever G.

The reservoir B communicates by the pipes L with an elastic and gas-tight pouch M. One of the faces of the pouch is confined by a strap, so that when it is inflated it expands chiefly on the side of the plate on the lever I.

The gas escapes from B through a tube O, and enters the main after passing through a purifying chamber P, containing cotton or similar substance, and also a layer of desiccating matter, on gratings or perforated partitions.

The upper part of the apparatus, comprising the carbide receptacle, &c., is secured upon the water-reservoir by a hinge, which enables the interior to be readily inspected, while hermetical closing is ensured by an india-rubber joint. Owing to the provision of a partition in the channel C, the carbide is only exposed to the action of the humid gas through the narrow orifice of the slide-valve; and so the carburet in store is protected from the premature action of moisture.

When in operation, the parts should be so adjusted that when the pouch M is inflated to its maximum volume, the slide-valve below the carbide receptacle is in such a position as to prevent the carbide from dropping into the water contained in the reservoir B. After a certain amount of gas has been produced (by manipulating the slide-valve by hand, so as to cause a sufficient quantity of carbide to fall into the water), there is developed a certain pressure within the apparatus, and the pouch M expands. When it is sufficiently inflated for the orifices in the plates below A to coincide, the apparatus will be in full operation, and may be left to itself. As the production of gas continues, the pouch becomes further inflated, and presently repels the plate which carries the lever G and the slide along with it. The descent of the carbide into the water accordingly ceases; production of gas is interrupted; and matters remain in this state until, as the pressure begins to diminish in consequence of the consumption of gas, the pouch becomes slightly disinflated, when the slide-valve will act and the descent of carbide into the water recommences, and with it the production of gas, which, in its turn, stops the further fall of carburet, and so on. Thus it will be seen, says the patentee, that the apparatus "exactly follows the fluctuations of consumption, and maintains itself at a constant pressure."

**Preparing Calcium Carbide for the Production of Acetylene.**—Lazarus, W. J. H., of Duren, Germany. No. 27,639; Nov. 24, 1897

This invention relates to the manufacture of "calcium carbide cartridges" for the production of acetylene gas; and it consists in first impregnating the calcium carbide with paraffin, or other cementing agent, then reducing the impregnated carbide to powder, and condensing the powder thus obtained into a compact body, or else forcing the powder into an envelope of sheet metal, and closing the filling-in end of the envelope by a substance impermeable to water and vapours. The object aimed at is to prevent "the evolution of gas taking place in a violent and irregular manner, so that the water is contaminated by the mud formed, and the partially exhausted cartridge, after removal from the water, does not allow of being exposed to the moist atmosphere above the water without gas still being evolved therefrom." The patentee acknowledges that it has before been proposed to grind the calcium carbide, to mix the carbide thus reduced with paraffin, resin, or other cementing agent, and to condense the mixture in order to manufacture cartridges for the production of acetylene gas. He therefore does not broadly claim the use of paraffin, or resin, or their equivalents in the manufacture of such cartridges, but as stated above.

**Acetylene Generators.**—Marechal, V., Moreau, A., and Garcin, L., of Paris. No. 29,405; Dec. 11, 1897. Date claimed under International Convention, June 11, 1897.

This invention has for its object to effect the constant and regular feeding of the water employed for the production of acetylene gas by providing a feeding tube of small calibre in which is a thread or wire, by means of which the capillarity of the tube is increased. The tube has its lower extremity outwardly flaring; while the lower extremity of the thread or wire exceeds the length of the containing tube.

**Automatic Gas-Lighting Apparatus.**—Rosinski, S., and Ducruix, V. E., of Paris. No. 7280; March 25, 1898.

This invention (applicable to gas-burners generally) relates to the automatic lighting of gas by the "mere act of turning on the gas to the burner." It comprises the provision of a material capable of being rendered incandescent by contact with the gas; of a branch-passage for directing a current of gas on to the material; and of means whereby the branch-passage is closed automatically on the ignition of the gas at the burner by the incandescent lighter.

The last-mentioned part of the invention consists in effecting the automatic closure of the branch-passage by the expansion of a fluid (or any other expansible body) acting upon an elastic bulb or membrane in such manner as to cause the latter, on the expansion of the fluid under the action of the heat of the burner, to shut off the branch-passage. This device consists of a tube having one end closed and the other open, but enclosed by an elastic cap or bulb of india-rubber. The tube contains mercury and a certain volume of air which, under the action of the heat of the lighted burner, is caused to dilate and expand the elastic cap or bulb, and so shut off the passage of the gas through the branch-passage. On the gas being turned off, the air and mercury cool and contract; the elastic membrane resumes its original form; and the passage is unclosed in readiness for the turning on of the tap of the burner.

The composition of the material to be rendered incandescent by the jet of gas consists essentially of gelatinous alumina, impregnated with a solution of platinum chloride, containing 1 gramme of platinum chloride to 4 grammes of alcohol.

**Incandescent Illuminating Bodies.**—Koch, A., of Bernau, Germany. No. 13,504; June 17, 1898.

This invention consists in combining with the method described in patent No. 30,145 of 1897, a "preparatory process" of impregnating the fabric or other material employed with an aqueous solution of thorium nitrate; the material being then dried, incinerated, and calcined. The preparatory process may, however, also be made use of in connection with the manufacturing of incandescent bodies in general, in order to improve their durability.

The patentee thus describes the mode of carrying out his proposal: A suitable fabric (of tubular form, but tapering towards the apex) is impregnated with a 30 per cent. aqueous solution of thorium nitrate; then freed by pressure from the adhering liquid, and dried; the dry fabric being subsequently incinerated, and then calcined and fixed in shape by the aid of gas under pressure. The resulting structure or body, which consists (apart from the natural ash-constituents) of pure thorium oxide, is then suspended from a hook, and dipped in a vessel containing organic compounds of silicon, mixed with an alcoholic solution of cerium, as described in the patent already referred to. A thorough moistening of the thorium structure is thus effected; and the latter is then, while still moist, ignited and calcined again for from one to three minutes. This operation results in the combustion of the organic compounds of silicon into silica, which "imparts to the structure a degree of solidity and elasticity hitherto unattainable." In addition to this, "the silica—by reason of its fine state of division on the thorium body, and in conjunction with the cerium—increases the illuminating power to a not inconsiderable extent."

## APPLICATIONS FOR LETTERS PATENT.

19,336.—Simon, W., "Acetylene gas-lamps." Sept. 12.
19,361.—Drake, W. A., and Marsland, J. S., "Inclined gas-retorts." Sept. 12.
19,369.—Boss, J., "Generating and utilizing acetylene gas." Sept. 12.
19,374.—Edwards, F., and Frazer, J., "Storage of acetylene gas." Sept. 12.
19,375.—Edwards, F., and Frazer, J., "Burners for acetylene gas." Sept. 12.
19,398.—Stent, W. K., "Gas-burners." Sept. 12.
19,461.—Spurge, J. B., "Valves for regulating the flow of gases and liquids under pressure." Sept. 13.
19,516.—Harris, A. C., "Gas and oil engines." Sept. 14.
19,526.—Walker, F. E., "Gas-brackets." Sept. 14.
19,529.—Young, W., and Glover, S. & T., "Improved method of separating from gases suspended particles, gases, and vapours, and for the distillation of liquids holding vapours and gases in solution, and in apparatus therefor." Sept. 14.
19,533.—Braham, R. W., "Regulating the consumption of gas through argand burners." Sept. 14.
19,549.—Browett, A., "Generating and burning acetylene gas." Sept. 14.
19,565.—Sachse, A. O., "Anti-vibratory supports for incandescent burners and mantles." Sept. 14.
19,641.—Donath, E., and Ornstein, E., "Obtaining prussian blue, prussiate of potash, and alkaline cyanides from used gas-purifying material." Sept. 15.
19,674.—Robinson, J. V., "Manufacture of acetylene gas." Sept. 16.
19,683.—Waite, T. R., "Acetylene gas generators." Sept. 16.
19,699.—Tourtel, J., and The Tourtel Gas and General Engineering Company, Ltd., "Coin-freed prepayment meters." Sept. 16.
19,706.—Cort, W. L., and Langwith, F. A., "Coin-controlled valve mechanism for gas-meters." Sept. 16.
19,757.—Landsberger, A., "Purifying acetylene gas." Sept. 17.
19,770.—Boult, A. J., "Metallic mantles for gas-burners." A communication from E. Verbecke. Sept. 17.
19,778.—Imray, O., "Bunsen burners." A communication from J. Moeller. Sept. 17.
19,779.—Imray, O., "Incandescent lamps." A communication from J. Moeller. Sept. 17.
19,786.—Bilbie, J., and Drivet, H., "Treatment of carbide of calcium." Sept. 17.

**The Proposed Purchase of the Falmouth Gas and Water Undertakings by the Corporation.**—At the suggestion of the Gas and Water Purchase Committee, the Falmouth Corporation have decided to again avail themselves of the services of Mr. A. Silverthorne, to advise them in connection with the steps to be taken for the purchase of the two undertakings. It has also been decided that the Town Clerk (Mr. J. H. Genn) shall act as Solicitor to the Corporation in the matter. Some discussion took place as to the Town Clerk's right to charge special fees in connection with the promotion of a Bill in Parliament. He said he wished to be perfectly frank with the Council. This would be an expensive business, and his charges would be made on the usual scale. He should consult Parliamentary Agents as to every step taken, for he declined to bear the responsibility of putting through a big scheme like this without having proper advice.

**Public Lighting in the Bradford Out-Townships.**—A deputation from the Chadderton District Council recently waited upon the Gas Committee of the Oldham Corporation to ask them to supply gas free of charge for the lighting of the public lamps in Chadderton. Mr. Taylor (the Clerk) said that in recent years the expenses of the district had been so enormous that the Council were looking round to see where they could cut them down; and this was one of the items on which they hoped to exercise economy. They thought they were justified in making the application, because the lamps in Oldham were lighted free of charge. After some discussion, the Town Clerk pointed out that if the Corporation supplied the out-townships with free gas for street lighting, they would be £2000 deficient. They would have to raise the price of gas; and as Oldham paid more than two-thirds of the total amount for gas consumption, the ratepayers of Oldham would be paying for the street lighting of the out-townships. Mr. A. Andrew (the Superintendent of the Gas and Water Department) said that last year £2356 was received from all the out-townships for public lighting. The surplus, after paying all charges and retaining the profit to which the Corporation were entitled, was £450. Deducting this surplus, it would be seen that the Corporation deficit, if the public lighting of the out-townships was done free of charge, would be £1900.

# CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

### The Home Office and Carburetted Water Gas.

SIR,—After an absence from home on holiday, I have read with considerable interest the valuable suggestions in connection with the above published in the "JOURNAL" for Aug. 23. The thanks of all gas authorities are due to you for expressing the sentiments prevailing upon the proposed legislative interference.

The statement of suppositious dangers reminds one of the difficulties experienced by the pioneers of coal-gas manufacture, and indeed by the pioneers of almost anything else. A strong representation to the Authorities at the Home Office would possibly be a distinct advantage. Nothing could be lost; while, on the other hand, something substantial might be obtained. A better object-lesson than the one you have named—that of the Government Vaccination Bill—could not be forthcoming at the present moment.

The chief difficulty arises in obtaining the requisite deputation for the purpose. Naturally the three London Gas Companies suggest themselves as eminently suitable for the purpose—namely, The Gaslight and Coke, South Metropolitan, and Commercial—although this is making a somewhat free use of their names. As, however, they are likely to be as largely interested in the subject as any gas undertaking in the United Kingdom, and are in close proximity to the Home Office, they could do what is necessary in the matter with a minimum of inconvenience.

The present users of carburetted water gas might, of course, combine for the purpose most effectually, if someone could be found to organize a representative deputation.

You clearly state that the best instructed technical opinion confirms that there is not any real question of public safety involved. While on the other hand, the advantage of being able, in case of emergency, to maintain a sufficient supply of light is a most important question of public safety. What evidence might be produced from some of the large cities and towns, where the pressures have had to be reduced to a minimum amount upon a foggy day! and where railway stations inundated with Christmas and holiday traffic and passengers have been subjected to almost Egyptian darkness! Apart from the fogs, the safety of the public during a strike or coal famine is a consideration. For the moment the economical side of the question is "out of court."

A clear statement setting forth the disadvantages of legislative regulations and restrictions as to the percentage of carburetted water gas permissible might perhaps be made to our Members of Parliament, and would be of assistance. The issue is one of national importance and consideration. Many gas undertakings are awaiting the decision of the "powers that be" upon the question of restriction, before erecting an installation of water-gas apparatus.

The present is the time for effectual action upon this highly important matter, although the holiday season is perhaps inopportune for several engineers.

*Huddersfield, Sept.* 20, 1898. EDWARD A. HARMAN.

### The Origin of Gas Associations.

SIR,—My interest in the gas business is now limited to a weekly reading of the "JOURNAL;" and I was much struck by the speech reported in your issue for the 13th inst., of Mr. J. C. Adamson, of Airdrie, on "The Origin of Gas Associations" when proposing the toast of "The Waverley Association of Gas Managers" at the recent meeting of that body. Mr. Adamson claims for the Association precedence of all others, and says that its formation suggested the organization of the society with which Mr. Mackenzie, of Dunfermline, was so long connected, now known as the North British Association of Gas Managers. This may be so; but it is the first time I have heard of it.

The North British Association arose in this way: In the summer of 1861, I had business in Cupar-Fife, and was accompanied by Mr. W. Proctor, the Gas Manager at Forfar, who was going to Cupar on a similar errand. After our business was done, we together called on Mr. Mackenzie, who at that time was Gas Manager there, where we found Mr. John Lowdon, the Manager from Leven. An adjournment was made to the Royal Hotel, and over a modest meal we discussed all sorts of matters affecting our industry—the doings of Mr. George Flintoff, &c. The meeting was altogether so pleasant and profitable, that we resolved "to meet some ither day," and to acquaint all the gas managers in Fife and Kinross, Angus, and Mearns of our intention, and to invite them by circular to be present. Mr. Lowdon was then appointed Chairman and Mr. Mackenzie Secretary; and we four pledged ourselves that, come who might, we would attend.

We were gratified next year to meet representatives from all the four counties to the number of 32. The business of the meeting consisted chiefly in framing the rules and regulations; and they remain almost identical as at that day. These rules were largely the work of Mr. Fraser, of Inverkeithing. Neither at this meeting nor at that of the quartet did I hear any mention of a similar society already formed or then in course of formation.

Perhaps this record will interest some of your younger readers in this northern province.

*Saltcoats, Sept.* 20, 1898. G. T. MYERS.

### Retorts.

SIR,—In his "Wayside Notes" in the "JOURNAL" for Sept. 13, as well as in his article on "Gaseous Fuel," on p. 590 of the "JOURNAL" for March 19, 1895, Mr. Cleminshaw states that from settings of six retorts in a bed—the retorts being 22 in. by 14 in. by 9 ft. long—he obtains good heats, so as to get a yield of 8000 cubic feet of gas per mouthpiece, and absence from choked pipes. He gets 888⅔ cubic feet in 1¾ cubic feet of retort capacity.

Allow me to ask him how many cubic feet of gas he gets from a ton of coal, and how many times he charges in 24 hours.

*Sept.* 14, 1898. A LESS FORTUNATE BROTHER.

# MISCELLANEOUS NEWS.

### INCANDESCENT GAS LIGHTING IN PARIS.

A recent number of the "Journal des Usines à Gaz" contains particulars as to the important extension of incandescent gas lighting, by Denayrouze burners, which has lately been carried out in Paris by the Gas Company and the Municipality. The portion of the city dealt with is the group of streets in the immediate vicinity of the Opera—the Rue Auber, the Rue du Havre, the Rue Scribe, the Rue Glück, the Rue Meyerbeer, and part of the Boulevard Haussmann. This system of lighting is also in use in the Place du Palais Royal, in the open space in front of the Hôtel de Ville, and in the Rue du Quatre Septembre—the street in which, it may be remembered, the first trials of improved gas lighting in Paris were made many years ago. The new system has been installed by simply substituting Denayrouze burners for the old types formerly in use; the lanterns being those generally employed in the public lighting of Paris. The burners are single, double, or triple, according to the extent of surface to be illuminated; their lighting capacity being respectively 173, 345, and 518 candles. The illuminating effect is therefore equal to, and even surpasses, that produced by the most powerful electric lights in use in the city. Comparing the present lighting of the Rue Auber with that of the Place de l'Opéra, into which it leads, and in which are installed electric lights, our contemporary says a very marked difference is at once presented in favour of gas, which is now shown to be capable of competing successfully with electric arc lighting for the larger public thoroughfares—a domain which has hitherto been considered exclusively its own. In addition to the greater quantity of light obtained, the new system will be productive of economy. The triple Denayrouze burners have replaced the recuperative burners which were formerly employed in lighting the above-named thoroughfares. When it is borne in mind that with the latter burners a minimum consumption of 1·4 cubic feet of gas per hour is required to produce the light of 9·6 candles, whereas a Denayrouze burner will furnish this quantity of light with about half a cubic foot, the advantage gained by the Municipality by the change of system will be readily appreciated. Moreover, it has been effected without necessitating any considerable expenditure for the alteration of existing plant and appliances—another point in favour of gas as compared with electric lighting.

The Denayrouze Company have taken very special precautions in the mounting of their burners, so as to protect the mantles as much as possible against injury from shock or excessive pressure of gas. To minimize the former trouble, the burners have been fitted with very sensitive anti-vibrators, which are stated to give excellent results in working; while the latter is obviated by the use of governors having pressure-gauges arranged to ensure a steady delivery of gas. As no chimney is required with these burners, there is necessarily no expense resulting from breakage of glasses. As far as the trial of the new system has proceeded, it has been found that the life of the mantles fitted up in the manner described has been considerably prolonged.

As to the general effect of the installation, our contemporary says the first impression produced is that of a powerful light to which one has hitherto been unaccustomed. The Rue Auber seems to be literally illuminated; the quantity of light thrown upon the street making the adjacent thoroughfares appear, by contrast, to be plunged in obscurity. Notwithstanding its intensity, the light is agreeable to the eye, due to the incandescent action being spread over the entire surface of the mantle. The effect of the electric arc is just the opposite of this. There the light-centre is much more restricted, and of unbearable brilliancy; while the light afforded is less evenly diffused. These points of difference make for the permanent success of the incandescent gas system.

### THE ACCIDENT FUND OF THE SOUTH METROPOLITAN GAS COMPANY.

#### Amendment of the Rules.

In the "JOURNAL" for July 20 last year, we gave an abstract of the rules in regard to the accident fund of the South Metropolitan Gas Company which had been adopted by the Profit-Sharing Committee and accepted by the employees. Experience of the working of the rules led the Committee to recommend certain alterations and additions, which have been adopted by the men; and the new rules have lately been certified by the Registrar of Friendly Societies. As the publication of the abstract drew our readers' attention to the rules, we now indicate the nature of the changes it has been deemed advisable to make in them.

The first important alteration is that the weekly or monthly subscription to the fund need not be paid in advance, as under the old rules. In Rule 6, bearing upon the accounts of the fund, the following paragraph has been added: "The reserve fund shall be used to make good any deficiency in any year, and for the general purpose of the fund; but should there be no reserve fund, then, in the event of a deficiency in any year, the Company shall make it good." According to Rule 7, as originally framed, the Company's contribution to the income of the fund was to be twice as much as that of the men. As altered, they will contribute "at least twice as much." Under Rule 7, as it stood, every man in receipt of weekly wages (including odd men) who accepted the proposal, was to pay in advance ½d. per week, 2d. per month, or 6d. per quarter, as most convenient. The new rule reads as follows: "Every man in receipt of weekly wages exceeding 21s. a week (including odd men) who accepts the proposal, shall pay in advance either ½d. per week, or 2d. a month, or 6d. a quarter, as may be most convenient. Young men and lads whose wages do not exceed 21s. a week shall pay half the above subscription, and receive half the benefits of full members." Considerable changes have been made in Rule 8, relating to the benefits. The allowances, with free medical attendance, for non-fatal accidents, were originally divided into three classes: Class A, for workmen whose injuries had been caused by their own gross negligence, 12s. a week; Class B, for pure accidents, not less

than 18s. a week; and Class C, for accidents clearly caused by negligence on the part of the Company or their officers, 24s. a week. Under the new rules, the allowances, with free medical attendance, are to be at the following rates:—

A.—Minor or slight accidents, disabling for not less than three days nor more than a fortnight, shall entitle members to benefit at the rate of 12s. a week, excepting those men who subscribe an extra 3d. per week to the sick fund, who shall receive in addition to the accident allowance the weekly payment to which the extra 3d. entitles them according to the sick fund rules.

B.—Serious accidents, causing incapacity for more than a fortnight, shall entitle members to benefit at the rate of 18s. a week.

C.—The benefit for accidents, clearly caused by the negligence of the Company or its officers shall be 24s. a week.

D.—Any member whose injuries have been caused by his own "serious and wilful misconduct," whatever may be the period of disablement, shall receive nothing from the accident fund, but will, if he is a member of the sick fund, receive benefit therefrom according to its rules..

The jury system adopted in 1892 is to be continued; and the class in which any man shall be placed is to be decided, in case of doubt, by the jury. In the event of any apparently slight accident put in the minor class and receiving benefit for the first fortnight at the rate of 12s. a week proving serious, it will be transferred from A to B, and, in addition to accident pay at the rate of 18s. a week, will receive towards the deficiency in the first two weeks an extra 3s. a week while incapacity continues; but the extra 3s. a week will in no case be paid for more than four weeks. These payments are to be continued until recovery, or until the doctor certifies that the man is fit for work, or until he is proved to be permanently incapacitated.

With regard to future employment, according to the old rules, in cases coming into Class A the Company gave no undertaking; but for those in Class B work would be found at not less than 24s. a week if the wages exceeded this amount, and in Class C at not less than four-fifths of the day wages previously received, and in no case less than 24s. if they exceeded that figure. The rules in this respect now stand as follows:—

To those men injured by their own "serious and wilful misconduct" the Company gives no undertaking as to future employment. Work will be found for others on recovery at not less than 24s. a week if the wages exceeded that amount; and for those injured by the negligence of the Company, at not less than four-fifths of the day wages previously received, and in no case less than 24s. if the wages exceeded that amount.

Rule 16, dealing with the conditions under which an allowance from the fund can be claimed, has been shortened. It now simply specifies that the accident must be proved to have occurred "while in the employ of, and actually engaged in, the work or business of the Company;" and in case of death or permanent disablement, the Profit-Sharing Committee are to decide what allowance shall be made, in accordance with Rule 8. Under the old rules, the inquiry into a claim in respect of an accident was to be made "as soon as possible;" whereas now it is to be made "within the first fortnight, if possible."

## SHREWSBURY GASLIGHT COMPANY.

The Annual Meeting of this Company was held on Wednesday last—Mr. J. S. Phillips presiding.

The report which was submitted stated that the available balance of profit was £2539; and the Directors recommended that the authorized dividend be declared. This (after deducting the interim dividend paid in March last) would absorb £2428, and leave a balance of £111 to carry forward. The consumption of gas showed a decrease of 1·23 per cent., principally due to the extreme mildness of the winter season. The unaccounted-for gas rose to 8·34 per cent.; many heavy leakages having been caused by damage to the mains through the sewerage operations which were in progress all the year. The residual products market had again been unfavourable; and a further advance had had to be conceded in the price of coal for the current year. At the beginning of 1898 the Directors decided to commence the supply of coin-meters, and also to let cooking and heating stoves on hire. Up to June 30, 241 slot meters had been fixed, and 82 stoves let on hire.

The Chairman, in proposing the adoption of the report, said that during the past year they had proceeded on the even tenour of their way, with the same successful results which had attended the Company for the last 78 years. The accounts showed that they had expended on capital account £1027 more than in the previous year, which was entirely due to the new departure entered upon during the last six months of the year, of supplying gas through slot meters and hiring out stoves. Since the prepayment system was commenced in January last, they had fixed 378 of the meters, and had received applications for 80 more. If the demand continued in anything like the same proportion, it would take a considerable amount of capital to supply the wants of their customers. Regarding the consumption of gas, during the year they made 153,738,000 cubic feet—an increase of 1,289,000 feet, or 0·85 per cent., over the previous year. But they had sold 1,715,000 cubic feet less, or a diminution of 1·23 per cent. The shareholders would naturally ask, having made an increased amount of gas, how it was there was less consumed. The fact was the unaccounted-for gas had increased from 6·95 per cent. to 8·34 per cent., which was entirely owing to the sewerage operations in the streets. During the year something like 256 tons of coal less had been used, which was equal to 1·85 per cent., although more gas had been produced. They had sold 10,125 cubic feet of gas per ton of coal carbonized, which was exceedingly satisfactory. On the revenue account they had received from the sale of gas and public lighting £20,974—a decrease of £244 on the preceding year, which was entirely owing to the mild winter. Up to the present, however, there had been a very satisfactory increase during the three months as compared with the corresponding quarter last year. The coal used had cost them more, although they used less, owing to having to pay an additional 6d. per ton, and keeping more in stock.

Mr. Beacall seconded the motion, which was carried unanimously.

The Chairman proposed the declaration of a dividend at the rate of 7½ per cent. per annum; less the interim payment of 3¾ per cent.

The motion having been carried, the thanks of the meeting were accorded to the Chairman and Directors and to Mr. W. Belton, the Secretary and Manager.

## ALLIANCE AND DUBLIN CONSUMERS' GAS COMPANY.

### Half-Yearly Report and Accounts.

In the report which the Directors of the above-named Company will present to the shareholders next Friday, they state that, after the payment of £5379, the interest on the loan capital, &c., there is a net profit of £32,182 on the past half-year's working. They recommend payment of the usual dividends of 10¼ and 7½ per cent. per annum on the respective shares. This will involve the withdrawal of £1384 from the reserve fund; but there will remain to the credit of the fund the sum of £42,875. The Directors express deep regret to record the death of their late highly-respected colleague, Mr. Edward Fottrell, J.P., who was a member of the Board during a period of more than thirty years, for twenty-five of which he was Chairman. They have elected Mr. Charles Lawler, J.P., to fill the vacancy. The Directors announce the resignation of Mr. W. F. Cotton, the Company's Secretary and Manager, and set forth the proposed arrangements consequent thereon, as indicated in the "Journal" last week.

The accounts accompanying the report show that the receipts for gas in the six months ending June 30 amounted to £109,689; rental of meters, to £3145; the sale of residuals produced £20,748; and the total revenue was £133,726. The expenditure on the manufacture of gas was £73,475 (coal costing £34,897, and cannel and oil £16,802); on distribution, £8261; on management, £5441—the total expenditure being £96,165—leaving a balance of £37,561 to be carried to the profit and loss account. The working statements show that the quantity of coal and cannel carbonized was 69,128 tons, which produced 699,040,000 cubic feet of gas. Of this, 621,849,000 cubic feet were sold and 631,636,000 cubic feet accounted for. The following are the estimated quantities of residuals produced: Coke, 88,340 chaldrons; breeze, 6773 chaldrons; tar, 642,096 gallons; and ammoniacal liquor, 1,513,704 gallons.

## OTTOMAN GAS COMPANY, LIMITED.

The Half-Yearly Meeting of this Company was held last Tuesday, at the London Offices, 9, Queen Street Place, E.C.—Colonel James Le Geyt Daniell in the chair.

The Secretary (Mr. T. Guyatt) having read the notice convening the meeting, the Directors' report and the accounts, which were referred to in the "Journal" for the 13th inst., were taken as read.

The Chairman, in moving the adoption of the report and accounts, said it would be remembered that at the last meeting the shareholders gave the Directors authority to issue some debentures; and these debentures, to the amount of £20,000, had been allotted. The sum of £17,740 mentioned in the accounts was the amount paid up on the debentures at the 30th of June last. Since that date, however, the whole amount due on them had been received. At the meeting of the Company twelve months ago, he had expressed the hope that the peace which was then signed would lead to an increase in the consumption of gas. This hope had in the past half year been fulfilled, though not to so great an extent as might have been wished. The increase in gas-rental for the six months under review amounted to £400; and of course there had been a corresponding increase in the receipts from residual products. Turning to the accounts, the item of sundry creditors, £1194, appeared somewhat heavy as compared with the corresponding period of the previous year; but this included an amount of £413 for gas-engines which had since been paid. Bills payable figured in the accounts at £3916; but since June the amount had been reduced to £838. Turning to the other side of the accounts, it would be seen that the capital expenditure stood at £74,485, from which had been deducted £372 for depreciation. The increase of £2600 in the capital account since Dec. 31, 1897, had been caused chiefly by outlay on new mains, and on the necessary excavations for the holder which they were erecting. It was estimated that the total cost of the holder would be £8500. The item of sundry debtors, £16,442, included a sum of £6000 which would eventually be charged to capital account, but which had been carried to suspense until the work in question was completed. Coming to the revenue account, coals had cost £3230, as against £2708. This increase was explained by the fact that they had carbonized 400 tons more, owing to the larger demand for gas which they had experienced. The negotiations for a new concession, to which he referred at the last meeting, had resulted in the Company being granted a further term of forty years, to commence at the expiration of the present concession in 1902. They had been trying to obtain an extension of seventy years; but he thought it would be safer to base their calculations on the forty years which had been granted. Such being the case, it would be necessary to formulate some scheme for a gradual liquidation during this period, by providing a sinking fund. They were, however, led to hope that ultimately the new concession might be extended to seventy years.

Mr. Stephenson R. Clarke seconded the motion.

Mr. A. M. Paddon asked whether anything had been done towards the introduction of prepayment meters among the consumers. He thought that the coinage in Turkey offered great facilities for the use of coin meters.

Mr. H. W. Andrews replied that the Company were at present making a trial of the system.

The Chairman, in answer to further questions, said that all the debentures had been taken up at par—there had been no underwriting. He had heard nothing more about the electric lighting company to which reference was made at the last meeting; but many people were going over to Smyrna with the idea of starting an electric lighting business. The Ottoman Gas Company, however, were entitled to preference in the matter of supplying electricity, if they offered to do so on as good terms as anyone else.

The motion was then carried unanimously.

On the motion of the Chairman, seconded by Mr. Charles Gandon, a dividend was declared at the rate of 7 per cent. per annum on both classes of shares.

A cordial vote of thanks was passed to the Chairman and Directors, on the motion of Mr. Hughes, seconded by Mr. A. W. Cooper.

On the motion of the Chairman, seconded by Mr. F. E. Linging, a like vote was passed to the officers and staff; and the proceedings terminated.

## THE PROGRESS OF THE SHEPPY GAS COMPANY.

The approaching relinquishment by Mr. A. W. Marks of the secretaryship of the Sheppy Gas Company, to which brief reference was made in the last number of the "JOURNAL," calls for more extended notice, not only from his long tenure of the position he is unfortunately compelled, mainly owing to failing health, to vacate, but from the fact that to his occupancy of it must unquestionably be attributed the success which has attended the undertaking. Mr. Marks entered upon his duties in 1862, having previously been engaged under the London and North-Western Railway Company at Camden Town, and for a few years in his father's business at Sheerness. At that time the Company whose service he entered were competing with the Sheerness Gas and Coke Company, who were selling gas at 7s. 6d. per 1000 cubic feet, under many disadvantages. The new Company started to sell at 5s.; and they very soon bought out the old Company. The capital of the Company was less than £8000; and the consumers did not number 300. The Company was re-incorporated by Act of Parliament in 1871. The capital is now £40,000; and the number of consumers upwards of 1500. The original price of 5s. has been gradually reduced to the present figure of 3s. per 1000 cubic feet net. Full dividends have invariably been paid, with the exception of the years of the coal strike some time ago. The Company were among the first to introduce—in 1865—the "fittings on hire" system, which worked very successfully for many years, but has more recently been almost superseded by the supply of fittings and stoves, of the purchasers' own selection, on the three-year system of payment. This is suitable for the better class of consumers; while the "penny-in-the-slot" arrangement suits the poorer classes. Nothing striking is to be noted in the history of the secretaryship except steady hard work, which has been remunerated with increased salary and assistance in the routine duties. Mr. Marks has always had the full confidence of the Directors, with whom he has acted in the most friendly manner; and all his proposals for reductions in price and improving the business of the Company have met with ready support alike from the Board and the proprietors. His resignation will, we are sure, be a matter of regret to all the Directors personally, and to many of the shareholders with whom he has been brought into more immediate contact.

## COLONIAL GAS UNDERTAKINGS.

In the "JOURNAL" for the 13th inst., we gave a report of the annual general meeting of the Australian Gaslight Company, with the results of the working in the six months ending June 30. The accounts of other colonial gas undertakings have since come to hand, from which the following particulars are extracted:—

The Maryborough Gas Company realized £2769 from the sale of gas, gas-fittings, &c., in the half year ending June 30; and the total revenue, with the balance of £1012 brought forward, was £3934. The profit for the six months was £1049; but after deducting £38 for dividend tax, there was £1011 standing to the credit of the profit and loss account. At the meeting of shareholders, the Directors recommended that this should be appropriated as follows: Dividend at the rate of 6 per cent. per annum, £772; balance carried forward, £239.

In presenting their fifteenth annual report and balance-sheet to the shareholders of the Perth Gas Company, Limited, the Directors congratulated them on the increased business and profits of the Company for the year ending May 31 last. The Company supply both gas and electric current; the profit from the former being £8709, and from the latter £3390, together, £12,099. A forfeited deposit of £1000 and a balance of £1472 brought forward made up £14,571, out of which an interim dividend of £1850 had been paid for the six months ending Nov. 30, 1897; leaving £12,721. This the Directors proposed to appropriate as follows: Dividend for the half year at the rate of 2s. per share, £3700; bonus of 1s. per share, £1850; reserve fund, £4666; balance carried forward, £2504. The Directors have decided to further extend operations, by laying mains and erecting cables for the supply of gas and electric current for lighting and cooking purposes, throughout the portions of the city and suburbs not already served; and with the object of encouraging the day consumption of gas, at a reduced price, they are importing a large stock of cooking-stoves. The Manager, Mr. E. Wigglesworth, was sent to England in December last to purchase the necessary machinery for duplicating the present supply of both lights; and contracts have now been completed. For these extensions more capital will be required; and for this purpose 13,000 new shares have been issued. Since the failure of the negotiations for the sale of the Company's business, the Directors have received several offers to purchase; but they have not entertained them. They recommend a reduction of 10d. per 1000 cubic feet on the present price of gas (10s.), with a discount of 10d. per 1000 cubic feet for payment on or before the 15th of each month. Also a discount of 2d. per unit on the price of the electric current (1s.) on the same terms.

The Rockhampton (Queensland) Gas Company, Limited, like the Company just noticed, supply both gas and electricity. In their fifty-first half-yearly report, embracing the six months ending June 30, the Directors express their pleasure in stating that the result of the operations in both sections of the business shows an improvement; and as regards the consumption of electricity, it is expected that during the current half year a still further one will be manifested. A large number of remunerative extensions of mains and services have been made, and applications are in hand for others. The gas operations show a profit of £2142, which is an increase of £316 on the preceding half year, and of £423 on the corresponding half of 1897. On the electrical operations there is a profit of £190, also indicating improvement. The total profit (£2332) from the two sections of the business has been added to the credit of the profit and loss account. After providing for interest on debentures, &c., and dividend duty, a credit balance of £1916 remains; and from this the Directors recommend the payment of a dividend at the rate of 7 per cent. per annum upon the ordinary shares, and 9 per cent. per annum upon the preference shares, amounting to £1683, free of dividend duty, and the placing of the balance (£233) to the credit of the reserve fund for the maintenance and improvement of plant.

The South Australian Gas Company received £76,991 from the sale of gas, residuals, &c., in the year ending June 30; and the total revenue was £77,260. The expenditure being £46,900, there was a balance of £30,360. Owing to various reductions made in the charges for gas, the receipts for the past year were rather less than those of the preceding twelve months; but the expenditure for coal and maintenance being reduced, the balance of profit is slightly better. As it is proposed to proceed with certain alterations to mains, services, and buildings, the Directors have decided to add £2000 to the replacement fund. New and larger purifiers are being fixed at Brompton; and considerable extensions of mains and service pipes have been made. Additions to plant have also been carried out at the Port Adelaide and Gawler works. The Adelaide Corporation having entered into a contract with the Company for street lighting for five years from September, 1897, more than 900 Welsbach incandescent gas-burners have been provided and fixed by the Company in the City lamps; and the lighting has consequently been much improved. Lamp contracts for five years have also been arranged with neighbouring Councils. The above-named balance of £30,360 added to the amount brought forward (£14,193) made a total of £44,553. The interim dividend absorbed £15,000; and the payment of the final dividend took a like amount—leaving £14,553 to be carried forward.

## THE PROPOSED LIGHTING OF BUCKPOOL BY MEANS OF ACETYLENE GAS.

Reference was made in the "Notes from Scotland" in the last number of the "JOURNAL," to the proposal which recently came before the Buckie Police Commissioners to light Buckpool by means of acetylene gas. It may be remembered that the Bon-Accord Acetylene Gas Company sent to the Commissioners an estimate of the cost of providing and fixing the necessary plant, on the assumption that the extent of main piping to be laid did not exceed three miles, and that the number of lamps to be supplied with the gas was about 60. As a guarantee of the efficient working of the plant, the Company were willing to put in the installation free of expense to the Commissioners in the first instance, and to work it themselves up to the 1st of May, 1899, on the understanding that from the time it was in working order till that date the Commissioners should take their supply of light for the 60 lamps in question from them, paying them at the rate of 7s. 6d. per 100 cubic feet (the equivalent of coal gas at 5s. per 1000 cubic feet) for it, and that on the above-named date they should take over the whole plant, paying for it the sum of £564—being £550 the original cost of the installation, and £14 as interest on £550 for 6½ months at the rate of 5 per cent. per annum—provided that by that time the working of the plant should have been shown to be satisfactory, and that it was in all respects suitable for what was required of it. The outlay for the piping and laying it was estimated at £155 per mile; and the cost of adapting the existing lamps for use with acetylene gas was put at 10s. apiece. The pipes were to be of galvanized wrought iron, and laid at a depth of 30 inches. As this is a definite proposal for an installation of acetylene gas lighting, it may be of interest to give all the figures of the estimate: Piping, 3 miles, at £155 per mile, £465; adapting 60 lamps, £30; No. 4 generator, £40; house for ditto, £10; fixing and starting generator and rail freight on all plant, £5—total, £550. Adding interest, Oct. 15, 1898, to May, 1899, at 5 per cent. per annum, £14, brings up the total to £564.

When the matter was before the Commissioners, the Provost (Mr. Webster) referred to the experiment which is being made with acetylene gas for lighting the neighbouring burgh of Portsoy; and he suggested that the Commissioners should wait and see the result before doing anything in the same direction themselves. This suggestion was supported by Mr. Archibald, who thought it would be wise to wait a little. Whenever they found the thing was really a success, they could deal with it. Bailie Bremner referred to the lighting of the Manchester Ship Canal by acetylene gas, and stated that it had been a success there. He had himself three burners, and was quite satisfied with the result of the installation. Mr. Flett said that, from personal experience, he had found the light excellent. He had it in his yard at Stornoway, where four jets of acetylene gave as much light as 16 ordinary gas-burners. He moved that the offer be accepted. Bailie Bremner seconded the motion. Mr. Archibald again counselled delay until the results at Portsoy were before them; and he moved, as an amendment, that no action be taken. This having been seconded, a further amendment was submitted by Mr. Simpson, to the effect that the Commissioners should make inquiries, with the view to the adoption of acetylene gas for the lighting of Buckpool. Mr. Archibald withdrew his amendment, and that of Mr. Simpson was carried by eight votes against four for the original motion.

**The Godalming Town Council and the Water-Works.**—As a result of negotiations between the Godalming Corporation and the Directors of the Frith Hill, Godalming, and Farncombe Water Company, an extraordinary meeting of the shareholders was held on Monday last week, at which a resolution was proposed agreeing to the acquisition of the water-works by the Council for the sum of £51,000. Although there was a majority in favour of the municipalization of the undertaking, there was not a three-fourths majority, as legally required; and the resolution was rendered abortive. In consequence of this, Mr. J. C. Collier, the Chairman, resigned his position as a Director.

**Hull Corporation Gas Supply.**—Progress is being made with the arrangements for changing the supply of gas in the area of Hull now served by the gas-works which the Corporation acquired from the Kingston-upon-Hull Gas Company, and which are to be dismantled. At the meeting of the Gas Committee last Tuesday, the Town Clerk submitted an agreement which, after considerable negotiation, had been come to with the British Gaslight Company for the supply of gas. The Company are to supply the gas at 1s. 6d. per 1000 cubic feet; and arrangements are made for the revision of the charge at certain intervals—the price to be raised or lowered according to actual cost in the Company's holders. If the Council desire it, instead of going through the books to find the cost, the Company are to charge them 4d. less than the other consumers. The agreement was confirmed. The Committee have also selected a site (for which they are to pay £2000) for the station meter and other purposes connected with the department.

## ELECTRIC LIGHTING NOTES.

The Electric Lighting Committee of the Cardiff County Council have received the sanction of the Local Government Board to the borrowing of £28,125 for electric lighting purposes.

With a view to encouraging the use of electric motors, and securing a day load for the generating plant, the Electric Lighting Committee of the Walsall Town Council have decided to make a special charge of 2½d. per unit for current supplied for motor purposes only.

The Rottingdean Electric Light Company must be in exceedingly low water. They were summoned at the Lewes Petty Sessions last Tuesday for allowing smoke to issue from the chimney at their works in such a manner as to cause a nuisance. Defendants, who were represented by their Manager, pleaded guilty, and were fined £1 and 14s. 6d. costs. The Manager asked for time to pay. The Chairman: What, time to pay £1 14s. 6d.! The Manager: Yes, we are in rather a bad way. Under such circumstances, the Bench could not do otherwise than grant the application.

The Vestry Clerk of Hampstead reported at Thursday's meeting that the accounts of electric light consumers for the Midsummer quarters in 1897 and 1898 were respectively £2119 and £3260—an increase of £1141. In his annual report on the work of the Vestry, the Clerk, referring to the fact that nearly every street of importance in the borough is wired, declares that "the Vestry are therefore in the enviable position of being able to face with confidence the threatened competition from outside companies, even if, as appears doubtful, those companies should be successful in obtaining the powers which they seek." The growth of income during the year shows an average increase of about 48 per cent. Another paragraph contains the remark that "the item for compensation also swells the expenditure this year, owing to the unfortunate fatal accident to one of the Vestry's men in a transformer in March, 1897."

The report of Major Cardew, R.E., to the Board of Trade, on the result of his investigation into the explosion of gas in the electric lighting culvert at Bottom-of-the-Moor, Oldham, on the 10th ult. (*ante*, p. 390) was recently read to the Electric Lighting Committee of the Corporation. Major Cardew, after stating the cause of the explosion, mentioned that the large culvert had since the accident been replaced by iron pipes containing insulated cables in place of bare conductors. There were, however, long lengths of similar culverts still in use in other parts of the town. None of these were at present ventilated, and any of them might become receptacles for explosive gas. The Inspector discussed the matter with the officials; and it was agreed that the following alterations should be carried out with the view of avoiding risk of future explosion: All service lines to arc lamps to be replaced by armoured cables laid solid without pipes; all pipes communicating with culverts or street boxes to be plugged at the ends; long lengths of culvert to be broken up by interposing at intervals cables laid on some solid system instead of the existing bare mains; all culverts to be ventilated as well as can be arranged; frequent inspection to be carried out, and covers of street-boxes to be lifted for such time as will allow of change of air. The Inspector did not think anything further could be done. The ventilation of these culverts, he remarked, appeared to be very difficult to carry out in a satisfactory manner; and frequent inspection was probably the best safeguard.

## PROJECTED ELECTRIC LIGHTING SCHEME FOR ADELAIDE.

As mentioned in the article on "Colonial Gas Undertakings" which appears elsewhere, the South Australian Gas Company have a contract with the Adelaide City Council for lighting a large portion of the city by incandescent gas-burners for five years from September, 1897. The effect produced by the new lighting must be eminently satisfactory; yet a short time ago the Council advertised for tenders for alternative electric lighting schemes. The first was for the right to light the city throughout for a term of 21 years, at the end of which the whole of the plant, works, &c., are to be handed over to the Corporation as a going concern free of cost; the second was for the private lighting of the city for a term of seven years from Dec. 31 next. Four tenders were submitted; and at the date of last advices, they were being considered by the Council.

The Brush Company undertook to put down the necessary plant, machinery, and mains for the supply of electricity to private consumers and to the Corporation for street lighting as required, and to maintain a continuous and constant supply. The maximum rate to be charged to private consumers was to be 9d. per Board of Trade unit; and the Council were to have the right to purchase the whole undertaking at the expiration of 42 years at the then value of the plant, works, mains, &c. When the earnings of the undertaking exceeded 10 per cent. per annum, the price of current was to be reduced to private consumers ¼d. per unit below the maximum rate allowable for every 1 per cent. in excess of this rate of profit. The Corporation were to give the Company the sole right of laying mains and supplying electricity for lighting purposes within the city area for a period of seven years. In consideration of the Company being granted this right, they undertook to supply the Corporation with current for street lighting at 5d. per unit. At this rate a 2000 nominal candle power lamp, running from sunset to midnight every night throughout the year, would, they said, cost £23 per annum; and from sunset to sunrise, £45 per annum. Although they had stipulated for the right to charge private customers 9d. per Board of Trade unit, it was most probable that the rate first fixed would be considerably below this. They added: "It is obviously not to the best interests of the general ratepayers that we should offer to do any street lighting free of cost, as it only means that private consumers have to be taxed by increased rates for their supply to cover the cost of the public lighting, which should rightly be borne by the whole of the ratepayers, and not by those who are sufficiently enterprising to adopt the new lighting."

The General Electric Supply Company of South Australia made the following tender for the private lighting: The Company to erect the necessary generating works and lay mains in certain streets named and such others as might offer sufficient inducement, and subject to the consent of the Corporation; and the Corporation to transfer their powers in regard to electric lighting to the Company for seven years. In consideration therefor, the Company undertook to supply, fix, and run from dusk to midnight, 20 arc lamps, each of 2000 nominal candle power, free of cost to the Corporation for the term mentioned in the specification. The Company were prepared to pay the Corporation 10 per cent. of all net profits over and above 6 per cent. interest on the capital cost of the works for private lighting in the city, or all the net profits over and above 10 per cent. The Company were further prepared to introduce a refuse destructor plant in connection with their works, should the Corporation be willing to enter into an agreement for delivery of all refuse free of cost to the Company. At the end of the term of seven years, if the agreement with the Company was not renewed for a similar term and on like conditions, the Corporation were to purchase at a valuation the whole electric installation for the street and private lighting as a going concern. In the event of the tender being accepted, the Company would be prepared to have the arc lamps fixed and running early in November.

A private firm submitted a tender for the second scheme, which contained the provision that if they secured the contract they would be prepared to put up 20 arc lamps, erect and maintain the whole of the fittings and supply the current for lighting the lamps free of all cost to the Corporation for the term of seven years. They were also prepared to pay to the Corporation a lampage of 2s. per lamp for all lamps installed (outside the area they at present light) for the purpose of private lighting from one central station during the above-named term, such payment to be made annually.

The South Australian Electric Light and Motive Power Company, Limited, offered to undertake the private lighting of the city for seven years from Dec. 31, 1898, on the following terms: The Company to supply to the Corporation free of all cost for public use 30 arc lamps of 2000 nominal candle power; to erect the lamps at their own cost in such places within the city as might be agreed upon; and to maintain them in proper and efficient condition, and cause them to be kept alight from sunset to sunrise. The Company offered to deposit with the Corporation the sum of £500 on the execution of an agreement making the Company's Private Act of Parliament apply to the city of Adelaide, after a poll of the ratepayers sanctioning it. In the event of the Company's offer being accepted, they were prepared to deposit with the Treasurer of the province the sum directed by their Private Act—viz., £5000. It appears that the Act referred to was obtained by the Company last year, and was very different from the one they wanted. However, since they have had it they have been endeavouring to raise money in London; and the foregoing particulars will give an indication of the kind of contract they were anxious to secure.

## PLYMOUTH WATER SUPPLY.

### Completion of the Burrator Storage Reservoir.

The annual "Fyshynge Feaste" of the Plymouth Corporation, which was held last Wednesday, was associated with the formal recognition of the completion of the new storage reservoir which has been constructed at Burrator, on the slopes of Dartmoor. For three centuries Plymouth has derived its water supply from the River Meavy, across which the Corporation, in the year 1584, obtained parliamentary powers to construct a weir and to abstract as much water as would flow into "a diche or trenche conteyneng in bredthe betwene sixe or seaven foote." There was no stipulation as to the depth of the "diche," and no provision for compensation water. Sir Francis Drake made the "diche," or leat; and, with the addition of several small storage reservoirs at various points, and other improvements, it afforded Plymouth an excellent and abundant gravitation supply, with which little fault has been found until recent years. Then it began to be discovered that the population had overtaken the means of supply. On two memorable occasions—that in the year 1881, and again in 1891—the leat was blocked by snow and frost, and had to be cleared, at great cost of money and labour, to relieve the water famine which ensued. At other times trouble has arisen through dry seasons. The capacity of the leat was equal to the demands so far made upon it; but more than once, in periods of drought, the river has fallen so low that the yield has been insufficient to maintain the full supply to the town. In spite of the fact that every drop of water has been diverted at the Head Weir into the leat, the town supply has had to be discontinued at night for several weeks past. In order to provide against difficulties of this kind, the Corporation were advised many years since to construct a storage reservoir. So long ago as 1848, Mr. Nathaniel Beardmore recommended this course; and in later years similar advice was received from the late Mr. T. Hawksley, Mr. Inglis, and other engineers. But though they sought advice, the Corporation did not attempt to act upon it until the experience of the year 1881, when the supply was cut off for a week, convinced them that action was necessary. Then, as readers of the "JOURNAL" will remember, ensued a wearisome and costly dispute over the best site for the proposed reservoir. The town was divided into two parties, one of which was in favour of embanking the river at the Head Weir, while the other wished the reservoir to be made at another place known as Harter. In the end, both of the projects were abandoned—the Harter site being rejected by popular vote, and that at Head Weir proving unsuitable because of the nature of the foundation.

Matters were in this position when the blizzard of 1891 came to remind the town of the serious consequences of delay. In that year, Mr. E. Sandeman was appointed Water Engineer, with instructions to report upon a scheme for the improvement of the water supply. He advised the embankment of the river at a point known as Burrator Gorge, where it ran through a narrow and rocky channel. This site had been suggested by Mr. Beardmore, as well as by Mr. Inglis, many years before; but so eager was the dispute over the other sites that their recommendations received scant attention. Mr. Sandeman also recommended that a direct main should be substituted for the winding leat, which in its course over moor and downs paid a heavy toll in leakage and evaporation, and which was also exposed to the dangers of contamination and the risk of being blocked in bad weather. A conspicuous merit of this plan was that it united all parties in the town. An Act of Parliament authorizing the works recommended was obtained in 1893. By May, 1894, the pipeline was completed. The mains are 25 inches in diameter; and they were laid in a direct course from the Burrator Gorge to the first of the Corporation reservoirs at Roborough. The length is 4½ miles, instead of the 8 miles traversed by the windings of the leat. At the same time,

preparations were in progress for the construction of the Burrator reservoir, which has now been completed. Some account of this undertaking has appeared in the "JOURNAL" as the work has proceeded (see Vol. LXXI., p. 958); and it need be only briefly described now. Its chief feature is a masonry dam which crosses the gorge at Burrator. This dam is 410 feet long at the parapet, and 361 feet at the water-level. The height is 77 feet from the river bed, where it is 62½ feet wide; the thickness at the top being 21 feet. Above the dam is a roadway 18 feet wide, carried over the centre of the structure by five arches, each with a 25-feet span, under which the overflow water will pass. In excavating for the foundations, it was necessary to go down 53 feet below the level of the river; and the height of the structure from the lowest point excavated to the top of the parapet is 145 feet. Close upon 32,000 cubic yards of material were taken out. All the fissures in the granite on both sides of the valley and below the river bed were cut out by hand labour; no explosive being used in the excavation, in order to avoid creating any further cracks and crevices in the rock. The face and top of the dam have been constructed of uncoursed ashlar, consisting of square blocks of granite; and the core of the structure is composed of cyclopean rubble, consisting of large masses of granite embedded in concrete. In the construction of the core, the granite blocks, some of them weighing several tons, were placed as close together as possible without touching. Each stone before being put in position was carefully washed and scraped, then bedded in 4 inches of cement, beaten down by heavy malls, and then filled round with concrete. On the side of the dam which has to resist the water pressure, the granite blocks have been rebated to a depth of 6 inches; leaving a space ⅝ inch wide to that depth between each of the blocks. The spaces have been filled in with neat cement slightly damped, and driven in by an iron chisel. By this process an exceedingly hard and water-tight joint has been obtained, so as to make the face of the dam absolutely impervious, and prevent water percolating into the core of the structure. Altogether, some 40,000 cubic yards of masonry and concrete, representing about 60,000 tons of material, have been built into the dam. Great care has been taken in the mixing of the concrete; and exceptionally heavy density was secured by the use of a spiked rammer invented by Mr. Sandeman. The dam was so designed that the pressure of the water against it compared to the resistance of the dam against overturning is as 1 : 3¼. In this calculation, the weight of the structure alone was taken into consideration, and the binding effect of the cement omitted, although it adds enormously to the strength of the dam. During the early stages of the work, the river was carried over the site by means of a lander; but as the building of the dam progressed, a tunnel 10 feet in diameter was made on a level with the old river bed, and the stream flowed through this. Two pipes have since been laid in the tunnel, for the purpose of connection with the pipe-line to Roborough; and the tunnel has been permanently closed by an iron shield placed over the entrance—the interior being filled up with concrete. At the level of the leat, a 35-inch steel main pierces the dam. Its purpose hitherto has been to carry forward the water of the leat; but eventually it will be a supplementary outlet for the supply from the reservoir.

A second dam has been constructed farther up the valley, near the village of Sheepstor, where there was a depression in the land. This embankment is only 30 feet above the ground level; but its construction presented considerable difficulty, owing to the disintegrated nature of the soil and the existence of numerous veins of porous material in the rock. At its deeper point, the trench was excavated to a depth of 105 feet below the surface before solid rock was reached. The length of the trench was 700 feet, and along the whole of it a vertical concrete wall 5 feet thick rises to a height of 95 feet. Resting upon its wedge-shaped top rises the core of the embankment formed of clay. The reservoir face of the dam, which has a gradient of 3 to 1, is covered with granite pitching grouted in cement and sand; and the width at the top is 12 feet. A small masonry dam has still to be constructed at the head of the valley, to intercept any stones and *débris* brought down by the winter floods, and so prevent the rapid silting up of the reservoir. When full, the reservoir will be the nearest approach to a lake to be found on the whole expanse of Dartmoor. Its length will be about 1⅛ miles; its greatest width, half a mile; and its greatest depth, 77 feet. It will contain 650 million gallons of water, which, without any addition, is equal, at the present consumption of 5 million gallons per day, to 130 days' supply.

On Wednesday the members of the Town Council with the Corporation officials assembled at the Head Weir for what is expected to be the last time, and there drank the ancient toasts—in water "to the pious memory of Sir Francis Drake," and then in wine: "May the descendants of him who brought us water never want wine." Later in the day, the Mayor (Alderman J. T. Bond), who has been Chairman of the Water Committee during the period covered by the inception and execution of the scheme, performed the ceremony of laying the final stone of the embankment—a massive block of granite recording the dates of the commencement and completion of the work, with the names of the Engineers (Mr. James Mansergh and Mr. E. Sandeman, MM.Inst.C.E.), and the Chairman of the Committee. There was a large crowd present to witness the ceremony. Sir Massey Lopes, the owner of most of the land in the district, presented the Mayor, in the name of the Water Committee, with a silver loving cup as a memento of the occasion; and both spoke in high terms of the excellence of the work done by the Engineers and of the admirable conduct of the men who have been employed by the Corporation in carrying it out. It was mentioned that Sir Massey Lopes gave to the Corporation the land upon which the dam is built and other land in the neighbourhood from which the granite was quarried.

In the evening, a dinner was held in the Plymouth Guildhall—the Mayor presiding. The Recorder (Mr. H. E. Duke) proposed the toast of "The Mayor and Members of the Water Committee;" and Alderman C. H. Radford that of "The Engineers," whose services he warmly eulogized. Mr. Sandeman, who responded, expressed regret at the absence of Mr. Mansergh. With regard to the capacity of the reservoir, he said that the consumption of water in Plymouth was at present 5 million gallons a day; and when it reached 8 millions, the reservoir would be able to supply this quantity for a period of drought extending over five months. He had no fear as to the dam being sufficiently strong to resist the overturning forces, since it was designed to be three-and-a-quarter times as strong as those forces; and if the adhesion of the cement were reckoned upon, it would probably be ten times as strong.

## THE DRY WEATHER AND THE WATER SUPPLY.

### The Curtailment of the Supply at the East-End.

The most noticeable events of the past week in connection with the agitation which has taken place against the East London Water Company, in consequence of the compulsory suspension of the constant supply of water in their district owing to the long-continued absence of rain, were conferences held on Friday and Saturday with Mr. Chaplin, the President of the Local Government Board.

The deputation on Friday was composed of the Members of Parliament for Limehouse, St. George's-in-the-East, Bradford West, and Romford (Messrs. H. S. Samuel, H. H. Marks, Ernest Flower, and L. Sinclair). They urged that the Local Government Board should exert its influence with the East London Water Company with a view to the purchase of water from other Companies on an adequate scale in order to meet the present shortage, and that the Board should also represent to the Company the justice of foregoing a claim for rates in respect of water which had not been supplied. Mr. Chaplin, in reply, said that he had exhausted the powers of the Local Government Board, and had even gone somewhat beyond his legal powers in the course he had pursued. Before the scarcity of water had become known, or was even generally anticipated—namely, in the latter part of May—a letter had been sent to the Company on behalf of the Board inquiring as to the adequacy of the supply for the summer months, in view of a possible drought. Later on the Inspectors of the Board were instructed to furnish reports upon the subject. Furthermore, the Board had made the suggestions to the Company which had resulted in the establishment of the connections with other Companies now created and in process of completion. Mr. Chaplin gave an emphatic assurance that nothing in his power would be left undone to ensure to the East London water consumers the most ample protection that the department could afford, and to obtain for them all possible compensation for the inconvenience experienced.

The deputation on Saturday was organized by the Social Democratic Federation (represented by Mr. Hyndman, Mr. H. Burrowes, and Mr. G. Lansbury), and consisted of members of various East-end Local Authorities; Mr. H. R. Taylor, the Secretary of the East London Water Consumers' Association, being in attendance. Mr. Hyndman having formally introduced the deputation, Mr. Lansbury explained that it had been brought about by the people of the East-end at various public meetings; and they wanted to assure the Government that there was a feeling of indignation at a water famine occurring again in two years. The time had now arrived to pin the Government to what was actually required. One of the officials of the Local Government Board visited the East-end a few months ago, and said that the water question ought to be dealt with, and that it was a great shame the people were in this position with regard to the supply. The resolution the deputation had to submit was passed at a mass meeting held at Victoria Park, West Ham, and Trafalgar Square, and was as follows: "That this mass meeting of London citizens protests against the infamous conduct of the East London Water Company in cutting off the water supply of East London 20 hours each day, and calls upon the Government to use such pressure as is necessary to compel the Companies responsible for the water supply of the Metropolis to connect their mains, and so allow all classes to be treated alike; further, to call upon the Government to summon an autumn session to place the whole water supply under public ownership and control; and, further, to urge the people not to pay for what they did not get." They were being denied one of the necessaries of life by the East London Water Company; and their story that the consumers obtained so many gallons per head per day was simply nonsense to the people who lived in the East-end. The position was scandalous; and if the Government did not call Parliament together for an autumn session, they would be responsible for the water famine next year if there should happen to be a dry summer. The Government allowed a monopoly like the East London Company to leave the drains unflushed, and cause such a stench as to make life unbearable. It was just possible, after this fine weather, that a frost would follow; and then the people of the East-end would be deprived of water owing to frozen pipes. These views were supported by other speakers.

Mr. Chaplin said the case put before him, which was substantially the same as that submitted by the deputation of Conservative members on the previous day, might be divided into two categories—one dealing with the facts as alleged of the present situation in connection with the water famine (which he deplored as much as anybody); and the other containing certain charges levelled against the East London Water Company, the present Parliament, and the Government, not excepting himself. He had listened with pain to the description of the very serious condition of affairs in East London owing to the present drought; and no one was more sensible than he was of the inconvenience and positive hardship and suffering inflicted upon the poorer classes of the community, aggravated by an almost unprecedented heat. Therefore, he was not surprised that they should demand that this state of things should be permanently remedied. But before going into that question, there were others even more important—viz.: What was being done, what had been done, and what by any possibility could be done to relieve the strain of the present immediate urgency? They had referred to the great danger to health; and on this point he would quote the Local Government Board Inspector, who had been in constant attendance in the district, and whose report was more reassuring than the statements made by the deputation. Dr. Bruce Low said: "In the four weeks before the intermittent supply, the death-rate from all causes had begun to increase in London generally, but more particularly in the East London district. The increase has continued since the intermittent supply, but has been relatively less in the East London district than in London as a whole. The diarrhœa death-rate, which mostly affects young children, has proceeded in the same way as the death-rate from all causes. The increase in diarrhœa is usual in the months of July, August, and September, especially in hot summers such as the present. But the fact that the increase has been relatively less in East London than in London as a whole, since the constant supply in East London failed, is satisfactory, as suggesting that the scarcity of water has not had any appreciable ill effect in encouraging diarrhœa." [There were some murmurs at this point.] They must take the report for what it was worth; but he himself had every confidence in its accuracy. If the state of the public health was more satisfactory than in the circumstances

could have been expected, then it was very much owing to the admirable work which had been done by a great number of the Local Authorities during the drought. Their aid had been invaluable, and had been a most important supplement to the works which had been effected to increase the water supply. The importance of these additions would be seen when he put this statement before them: A pipe had recently been placed through the Blackwall Tunnel, carrying water from the Kent system; the quantity being 250,000 gallons per day. A junction had also been made with the Southwark and Vauxhall Company, which might be expected to give an additional supply of something like 6 million gallons daily. A connection between the mains of the New River and Grand Junction Companies, with the object of releasing an additional quantity of water from the Lea for the use of the East London district, would shortly be completed—probably within the next twelve days—and it was calculated that this would give a further supply of 4 million gallons per day. After giving particulars of other works which were being carried out, he stated that the deficiency which had necessitated the stoppage of the constant supply was estimated at 15 million gallons per day, and 12 millions of this deficiency would be met by the connections completed or in progress. Beyond this, he had before him further proposals from the Company, which, if carried out, would make up 16½ million gallons in addition to their normal supply before they approached the time of what he might call another dry season. The point which he regarded as of more urgency than anything else was, how it was possible, within the time, to prevent a recurrence of another famine, should there be another unfortunate drought during next year. In the opinion of the Local Government Board, the emergency, so far as next year was concerned, would be to a very great extent met by the Company's proposals. Turning from this point, he had to consider the question of a permanent remedy. The cause of the whole difficulty was perfectly simple, and it was explained by the Meteorological Office, from which he had been furnished with information as to the rainfall in London. The gist of it was that, comparing the rainfall in London during a period of 30 years with the rainfall from May, 1897, to the present time, these 17 months showed a deficiency of 12 inches of rainfall, or about 34 per cent., or less than two-thirds of the average for 30 years. In no corresponding period had the rainfall been so small as in the last 17 months. But then it was said, with perfect justice, that there were eight Water Companies in London; and it was asked why the East London Company always failed in times of pressure, while other Companies were able to continue their supply. Well, the answer was this: With two exceptions, all the other Companies drew their water from the Thames; and the Thames had never been known to fail in its supply. The East London and New River Companies, on the other hand, drew their supplies very largely from the Lea; and the East London Company was under the exceptional disadvantage that it could only draw its supplies from that river after the requirements of the New River Company had been met. The lowest quantity ever known to have been drawn from the Lea was about 11 million gallons per day. This had been going on for a great number of years; and it was upon this basis that all the East London Water Company's calculations of the requirements of the population of East London had been made. But this year the Company had only been able to draw daily from the Lea for a long time past, not 11 million, but 2 million gallons. The calculation based on a number of years having been upset, the Company could not be held responsible for failing—or, at any rate, it was a very substantial reason why they had failed—while the other Water Companies had been able to continue their supply. [Mr. Lansbury interposed the remark that their point against the East London Company was that they did not use the powers they obtained last year to make all these connections beforehand.] Mr. Chaplin said he was quite aware of that; but his point was that both the Company and the Board's own officers had been misled owing to the failure of the supply of Lea water. Continuing, he said the deputation had urged that there should be a connection made between the mains of all the different Water Companies in London. This was the opinion he himself had always held most strongly; and when the Government were charged with complete indifference on this subject, he would show that this charge was without any foundation whatever. The Government last year appointed a Royal Commission on the water supply of London, and they were instructed to inquire and report "whether it is practicable to connect any two or more of the different systems of supply now administered by the eight Metropolitan Companies; and, if so, by whom, and in what proportion should the cost of connecting them be borne, and what are the legal powers necessary to give effect to any such arrangement." It was an easy thing to say that all these Companies should be connected; but there were legal and other difficulties in the way which could only be elucidated by information gathered by a Royal Commission. There was this important difference between London and other great cities and corporations where the supply was in the hands of the representatives—that there was a very large area indeed now supplied by the London Water Companies which was entirely beyond the jurisdiction of the London County Council; and the ratepayers in that area had evinced the strongest objection to their water supply being placed under the control of the Council. They claimed, as the London people did, to have the control of their own water supply; and this was not an unnatural claim. As to the charges which had been levelled against the Government and the Local Government Board, he had only to say that he had spared no effort to alleviate the unfortunate water famine. He might mention that great exception had been taken to a letter emanating from the Board as to their views about the waste of water. Well, the Board were continually hearing of taps being left running; and the Water Company urged that, unless some economy in the use of water could be devised, they felt almost certain they would be obliged to further curtail the hours of supply. He wrote a letter to Mr. Steadman, M.P., pointing out this waste of water; but he had no intention of accusing the consumers of intentionally wasting the water supplied to them. His sole object was to warn the public that there was a danger of a further curtailment of the supply owing to waste. With reference to the East London Water Company, he made no charges against them, and he was not there to defend them. As to whether or not the Company had been remiss in their duty—whether they could have procured water earlier than they did—he must refrain from passing an opinion, for the question would shortly come before the Railway Commission. There was one other point of importance—viz., that in his interview on the previous day he was made to say in the daily papers that he gave an emphatic assurance that he would obtain for the consumers of East London, "all possible compensation for the inconvenience experienced." He did not quite know what this meant. Under the Act passed last year, it was provided that compensation might be given. But he was certainly not conscious of having made any statement of the kind; and it would have been highly improper to say so in view of the matter coming before the Railway Commission. As to the proposed autumn session, he had great doubts as to whether the works proposed could be carried out. The deputation attached much importance to the Water Companies being placed under the control of a public body; but this in itself was not a guarantee against the evils of which they complained, for in some parts of the country, even where water supplies were controlled by public authorities, they were suffering greater distress than the East-end of London. He concluded by expressing his sympathy with the deputation in the present emergency.

In the course of Mr. Chaplin's reply, he referred to the question of the East London water supply shortly coming before the Railway Commissioners. The Commission (consisting of Mr. Justice Wright, the Right Hon. Sir F. Peel, and the Right Hon. Viscount Cobham), had a sitting last Friday, and in the course thereof Mr. Cripps, Q.C., mentioned that an application was being made by the Hackney Vestry against the East London Water Company, under the Metropolis Water Act, 1897, by the provisions of which a local authority may complain to the Commission that any of the Metropolitan Water Companies have failed to perform some statutory duty. As representing the Company, he was anxious to court full inquiry into the matter; and he asked to have a day fixed for the hearing of the application. The Clerk to the Hackney Vestry (Mr. G. Grocott), was in Court, and said the Vestry were not prepared at present to have a day fixed, but they very soon would be. Mr. Justice Wright said that if the application had been considered by the Local Authorities as a matter of great public urgency, the Court would have made arrangements to give the matter as speedy a hearing as possible. This, however, did not appear to be the case. The Water Company were not in order in asking for the matter to be advanced; and their application would have to stand over.

#### The Position in the Provinces.

It is not in East London only that inconvenience is felt from the scarcity of water. The danger of a water famine is imminent in Birmingham, unless there is a break in the weather very soon. The streams from which a considerable proportion of the daily supply is obtained are yielding very greatly diminished quantities; and demands have to be made upon the reservoir storage to an extent which is causing the Water Committee of the Corporation to look to the future with alarm. Appeals have already been issued to the public to curtail as much as possible the use of water; and the Committee themselves have restricted the watering of the streets to a narrow area in the centre of the city. In the Chiltern Hills district of Buckinghamshire, great anxiety prevails, in consequence of the continued drought. In many of the upland parishes, the majority of the villagers depend upon tanks and cisterns; but these receptacles have been exhausted for some weeks, while the sources of supply from neighbouring ponds and wells have given out. In several instances, 2d. and 3d. per pail is paid for water; and during the past week one of the street-watering carts has been employed to convey a supply daily from High Wycombe to Hampden, a distance of about seven miles. A charge of £1 per cartload of water is made. The Great Missenden Parish Council have voted £25 towards supplying with water some of the parishioners living on the hills; and they have also appointed a Committee to devise the best arrangements in the interest of the parish generally. At Dunstable, many of the wells have given out; and the Water Company have lately had about forty applications for a supply. Serious inconvenience is being caused to villages in Northamptonshire, most of which are dependent upon surface springs. At the shoe-manufacturing town of Earl's Barton, the Surveyor has reported that there are only 6 inches of water in the reservoir. A number of isolated villages are without any water whatever. The scarcity of water is seriously affecting the South Staffordshire Water Company, who until recently had supplied their whole area in the Black Country in a very satisfactory manner. Last Friday they requested the various sanitary authorities to cease watering the roads. Old wells are being reopened in some cases. Householders are warned to be exceedingly careful, and not to use any more water than is absolutely necessary. As many of the districts depend almost entirely upon the street hydrants supplied by the Company, the consequence would be grave should there be any serious outbreaks of fire.

## HALIFAX CORPORATION WATER SUPPLY.

#### The Walshaw Scheme to be Carried Out.

A Special Meeting of the Halifax Town Council was held last Wednesday—the Mayor (Mr. J. H. L. Baldwin) presiding—to consider the recommendation of the Sub-Committee authorizing the Water Committee to carry out forthwith the works in connection with the construction of the Walshaw scheme of water supply, authorized by the Halifax Corporation Act of the past session, at an estimated cost of £157,000. The Sub-Committee had prepared a report, the adoption of which was proposed and seconded.

Mr. Hebden moved as an amendment that the Committee be authorized to carry out forthwith the works in connection with the upper reservoir of the Walshaw Dean scheme. He said the whole scheme included the constructing of three reservoirs. The average rainfall for the last forty years had been 46 inches; and with a continuation of such a rainfall, they would not require an additional reservoir for the next twenty years. He ventured to predict that the construction of the three reservoirs would mean a cost of a quarter of a million sterling. For the last ten years the requirements had been almost stationary. The one reservoir which he proposed should be constructed would have a capacity equal to 209 million gallons. The most serious question to take in hand was that of leakage. He showed that in the past an enormous quantity of water had run to waste.

Mr. MAUDE seconded the amendment.

Alderman WOODHEAD reminded the Council that it was for an exceptional year that they wished to provide. The most economical plan would be to put the Committee in a position to let the whole of the contracts at the same time; for by this course they would be able to save some thousands of pounds. The period Parliament allowed the Corporation for the completion of the entire works was ten years. He pointed out that in the application for the Act recently obtained they spent more than £2000. They had had to fight the West Riding County Council and the West Riding Rivers Board; and had they been compelled to insert such clauses in their Bill as these two authorities desired, it would have put the Corporation to an additional cost of £60,000. As a proof of the increase in the demand for water, he might say the receipts in 1878 amounted to £30,416; in 1883, to £33,164; and in 1898, to £46,919.

Mr. WADE (the Chairman of the Water Committee) pointed out that if one reservoir only were constructed, the 125 riparian owners on the line would be in a position to claim more water as compensation than the reservoir would contain.

The ENGINEER (Mr. J. A. Paskin) confirmed this statement.

Mr. HEBDEN thereupon withdrew his amendment.

Mr. J. T. SIMPSON expressed the opinion that they had an adequate water supply. No case of urgency had, he said, been made out. He moved that the consideration of the work of constructing the Walshaw Dean reservoirs be deferred for about two years.

Mr. KERR believed they had nothing to fear so far as the water supply was concerned for some years to come. He seconded the proposition to defer the matter.

Alderman BOTTOMLEY did not think they would be obliged to go to Parliament for the continuation of powers in case the reservoirs were not constructed in ten years. He protested against the monstrous expenditure proposed.

The ENGINEER stated, in answer to a question, that in 1887 the whole of the water in store was only equal to thirty days' supply.

The MAYOR spoke in favour of the Sub-Committee's report. He said that they would be glad to see the water-carriage system of sewerage adopted before long; and this would increase the consumption of water.

Mr. WADE explained that the rate-in-aid from 1858 to 1888 amounted to £86,635. This had, he said, all been paid with the exception of £18,000; and within the next two years the whole of the amount would be cleared off. It would take nine years to build the three reservoirs, the total capacity of which would be 630 million gallons.

The report was adopted; the voting for the proposal to defer the work being 14 in its favour and 27 against it.

## CARLISLE CORPORATION WATER SUPPLY.

### The Annual Accounts.

We noticed in the last number of the "JOURNAL" the accounts of the Gas Department of the Carlisle Corporation for the year ending June 30. The following figures relate to the Water Department: The amount derived from water-rental for the year, after deduction of discounts and allowances for empty houses, &c., was £9272. The revenue account shows a gross profit of £6056—an increase of £358 over the preceding year. After payment of income-tax, there is a sum of £5896 to be paid into the district fund. The payments out of the fund on account of water-works loans are: A year's instalment of loans, £1038; one year's interest, £377—leaving a balance available of £4481. This shows a considerable increase over previous years, owing to the fact that the loan contracted in 1866 for the purchase of the works has now been entirely repaid. For the year ending June 30, 1897, the gross profit paid into the district fund was £5558. The amount of instalments of loans for the year was £2071; and interest was £417—together, £2488—leaving an available balance of £3070.

## THE DERWENT WATER SCHEMES.

Yesterday week there was an important conference at Derby, in reference to the proposal of the Derby and other Corporations to secure the upper waters of the Derwent for the supply of their towns. The conference was between the Health Committee of the Derbyshire County Council and delegates from the various Urban and District Councils in the county. The proceedings were strictly private; and it has been impossible to obtain any information regarding them either from officials or delegates—it being considered that at this stage it would be premature to make any announcement. It is, however, believed that a Sub-Committee of the County Council and delegates were appointed to watch over the interests of the county.

It seems that the Corporation of Sheffield are by no means disposed to admit the claim put forward by Derby to the exclusive use of the waters of the Derwent; and for some weeks the matter has been under the consideration of the Water Committee. A Sub-Committee was appointed to get into communication with neighbouring towns, with a view to focussing opposition; and this Sub-Committee made a report to the Water Committee at a meeting held on Wednesday. After conferring by letter with the Authorities at Leicester, Nottingham, Rotherham, Doncaster, and Barnsley, the unanimous recommendation of the Sub-Committee is that, in default of a definite agreement being concluded with Leicester for joint action at an adjourned conference, the Council at once authorize the Water Committee to take all necessary steps to apply, without or in conjunction with the Councils of Nottingham, Rotherham, Doncaster, and Barnsley, or any of them, for a Bill to acquire the water supply of the Rivers Derwent and Ashop, or a competent share thereof. The report was adopted; and the Lord Mayor was requested to summon a special meeting of the City Council to consider the recommendations.

**Croydon Water Supply.**—The Local Government Board have refused to sanction the Croydon County Council's scheme for new water-works at Waddon. Strong evidence against the proposal was given on behalf of the riparian proprietors and millowners on the River Wandle.

## THE LANGSETT WATER-WORKS OF THE SHEFFIELD CORPORATION.

### The Safety of the Reservoir Embankment.

The Water Committee of the Sheffield City Council have published some important correspondence concerning the Langsett reservoir embankment. It indicates that in its construction they are proceeding with the utmost caution; and with the awful experience of 34 years ago before them, they have certainly good cause for anxiety. The correspondence opens with a memorandum, by Professor Boyd-Dawkins, on the result of an examination he made of the excavations so far carried out for the embankment; and this and a subsequent report were submitted to the Consulting Water Engineer (Mr. E. M. Eaton) for his criticisms. Dealing with the reports from the engineering point of view, Mr. Eaton disagreed in one or two important particulars with the Professor's conclusions, and also made additional recommendations. But finally the two experts visited the site of the embankment together; and on the following points there appears to be perfect unanimity: That the black shales on the sides of the valley are solid and offer an excellent foundation for the embankment; that it is unnecessary to excavate further into them on the north side, with the exception of a weak area of folded and crushed shale extending for a distance of about 30 feet in the line of the trench; that it will be necessary to deepen the trench in this weak area until a good foundation is reached; that it is expedient to sink a shaft to ascertain that the strata under the present bottom of the trench are sound; and that, on the north side where the top water-line cuts the rough rock (sandstone overlying the black shale), it is advisable to carry a wing-trench into the black shales at the north-eastern end of the embankment to prevent leakage through the sandstone. With regard to a slip on the south side, there is a unanimous agreement that it is expedient to remove it, irrespective of the question of its removal being necessary, which Professor Boyd-Dawkins does not admit. The portion of it in question is small and superficial; and its removal will entail very little extra work. There is a fault running across the valley to the east of the concrete trench. But it is small and unimportant, and will not affect in any way the stability of the works. Professor Boyd-Dawkins considers, from every point of view, that the site is a good one, and that the strata present no special engineering difficulties. Mr. William Walls, the Engineer for the Langsett works, has advised, and Mr. Eaton concurs, that the northerly or Langsett end of the trench should at once be refilled with concrete for a sufficient distance on either side of the shaft to afford a good foundation for the outlet tunnel; and, on the 7th inst., the Water Committee, after consideration of the correspondence, adopted this recommendation.

## THE EPIDEMIC OF TYPHOID FEVER AT MAIDSTONE.

### The Report to the Local Government Board.

In the "JOURNAL" for Aug. 30 we gave extracts from the report made to the Local Government Board by the three Inspectors—Mr. J. S. Davy, Dr. Theodore Thomson, and Mr. G. W. Willcocks—appointed by them to inquire into the cause and spread of the epidemic of typhoid fever which occurred about this time last year at Maidstone. The report contains a great mass of matter, including plans, maps, and diagrams. It opens with a brief sketch of Maidstone from a geological and commercial point of view, and then goes on to deal with its sanitary administration, sewerage and drainage, and water supply. A history of the typhoid epidemic is next given; the evidence adduced at the inquiry being exhaustively reviewed. The conclusions arrived at by the Inspectors are as follows:—

On a review of the whole of the evidence, we have no hesitation in coming to the conclusion that the epidemic was caused by the pollution of the water supplied by the Maidstone Company from their Farleigh sources. It is true that there is abundant testimony to show that grave sanitary defects exist in the construction of some of the sewers, and of many house drains and water-closets within the borough; while one of the expert witnesses, Dr. Corfield, said that, in his opinion, these defects were sufficient to account for the epidemic. But the sudden and simultaneous outbreak of fever over a wide area, and the rapidity with which the epidemic grew, cannot be accounted for by the existence of defective conditions of sewerage and drainage. Further, the facts as to the local incidence of the disease, which have already been stated, are not consistent with the theory that these conditions had anything to do with its origin. The old brick barrel sewers are almost all in the lower part of the town, which was comparatively free from attack, especially at the commencement of the epidemic, and the hand-flushed closets and defective house drains are distributed pretty equally over the whole town; whereas the cases of typhoid fever were confined to the Farleigh area of water supply to an extent which quite precludes the possibility of mere chance. It was suggested that the special incidence of the epidemic on this area was due to the fact that it includes the higher levels of the town, and therefore would be the most liable to suffer from the ill effects of sewer emanations. On the other hand, evidence was given that the direction of currents of air in sewers is frequently from the higher to the lower levels. However this may be, there are other facts which make the suggestion of little value in determining the cause of the epidemic. The incidence of the disease on that part of the rural district which has no connection whatever with the sewers of Maidstone, shows the same relation to the Farleigh water supply as that in the borough. And though the Asylum, which suffered heavily, drains into the Maidstone sewers, yet in this case there is no allegation of any defect of drainage conditions, flushing, or water-closet connections; while the Farleigh water was supplied.

It was objected that this evidence, strongly as it points to the pollution of the Farleigh supply, was circumstantial, and established grounds of suspicion only. But it was supplemented by other facts, which appear to us to leave no room for doubt. The chemical analyses of samples of water taken from some of the springs after the epidemic broke out show

that the Farleigh supply had been dangerously polluted; and the bacteriological examination of the samples from two at least of the springs afforded conclusive evidence of excremental pollution by man or the lower animals. Dr. Sims Woodhead, indeed, contended that his examination did not definitely prove that this was the case, and that the colonies which he found were merely indicative of what he called "surface relations." It would be beyond our province to discuss the difference of opinion between Dr. Sims Woodhead and the other experts who were examined as to the exact significance of the discovery of the *bacillus coli* in water, or as to the proper classification of bacteria of this species; but it may be pointed out that "relations" between water supplies and the "surface" of gardens and fields like those which surround the Farleigh sources must be extremely dangerous. And in this case the evidence shows clearly that the neighbourhood of some of the springs was, immediately before the outbreak, plentifully covered with human excrement. It has, moreover, to be borne in mind that Dr. Woodhead's samples were taken some time after the water had been examined by Dr. Washbourn, and that consequently the condition of the water may have altered considerably. The testimony of the scientific witnesses at the inquiry was to the effect that the *bacillus typhosus* is seldom or never recognized in water, so that the fact that it was not discovered in this case is not remarkable, even if no allowance be made for the time which had elapsed between the introduction of the poison into the springs and the examination of the water. With reference to the fact that there was no history of any recognized case of typhoid fever in the neighbourhood of the Farleigh springs before the epidemic, it may be remarked that cases of typhoid fever are not always recognized and notified.

As was pointed out at the inquiry, the hop pickers did not arrive at Tutsham until Aug. 26, while, according to Mr. M. A. Adams, there were four cases attacked in the borough during the week ending Aug. 28, and 29 during the week ending Sept. 4. But any inferences from these dates would only be material as relating to this particular group of itinerant labourers, and to the Tutsham-in-Field source; whereas the evidence clearly establishes that many of the other Farleigh springs were in the immediate neighbourhood of hop and fruit gardens, and that they were all exposed to the risk of pollution. The chemical analyses, the bacteriological examinations, and a consideration of the surroundings of the site, all tend to show that the Tutsham-in-Field spring was the most dangerous; but one of the chemical analyses shows that even the Ewell water, which must be regarded as the safest, was not absolutely free from suspicion; and Mr. Percy Adams at his first visit saw human fæces in dangerous proximity to two of the catchpits. It is true that during the epidemic, and since that time, a population of about 60 persons in the parishes of West Farleigh and Yalding was supplied with water from the Ewell springs exclusively, and that no case of typhoid fever is known to have occurred among them. On the other hand, 13 cases were notified from the Asylum after Oct. 10, when all the water except that from Ewell was cut off; and allowing a period of three weeks for incubation and notification, seven of these cases cannot be attributed to water supplied before the other springs were cut off, and must be otherwise accounted for. Two also of the three cases which were notified from the rural sanitary district after the beginning of November, resided in the area supplied by the Water Company with water from the Ewell springs only. As to whether these cases, either from the Asylum or from the rural district, are to be regarded as "secondary," no evidence was given—in fact, there is no conclusive evidence to show how the specific pollution of typhoid fever was introduced into the supply, or which of the springs was thus polluted.

The evidence given by Mr. Adams regarding relationship between the fever and conditions of rainfall and level of subsoil water as affecting the Farleigh sources of water supply, is of much interest. The facts adduced by him on this point, if they cannot be held as definitely proving the relationship he seeks to establish, are nevertheless suggestive of causative connection between these factors and the outbreak of typhoid fever. His contention, however, that these conditions were also related to prevalence of "premonitory" diarrhœa in the borough of Maidstone shortly before the outbreak of fever, is based on less sufficient evidence. Indeed, the data upon which this contention is based are too incomplete to warrant acceptance of the belief that the fever outbreak was actually preceded by prevalence of diarrhœa of a sort differing materially from the seasonal diarrhœa usual in towns during the summer. While this is so, yet the evidence, as far as it went, suggests that there had been a special incidence of diarrhœa on the areas within the borough of Maidstone supplied by Farleigh water; and that, in the opinion of at least some medical men in the town, the diarrhœa was of unusual character. These statements, coupled with there having been, mainly in August and September, an unusual prevalence of colitis in the Asylum, render it to be regretted that fuller evidence should not have been available on this subject.

There remain for consideration three contentions put forward by the Water Company:—

1.—That although the bulk of the fever cases occurred within the area supplied with Farleigh water, yet that there had been many in the Boarley and Cossington areas, and that these must have been due to other causes than consumption of Farleigh water.
2.—That between Oct. 10, 1897, and Jan. 20, 1898, 357 cases of typhoid fever were notified; but that, as all the Farleigh supply, except the Ewell and the Big Church springs, was cut off from Maidstone 16 days before Oct. 10, these 357 cases cannot reasonably be attributed to that water supply.
3.—That the causes operating to bring about these 357 cases may also have been operating during the earlier part of the epidemic, and thus have caused cases wrongly attributed to the Farleigh water supply.

As regards the first of these contentions, evidence was for the most part wanting to show how persons residing in the Boarley and Cossington areas, and attacked by the fever, had contracted it. It was suggested that they had drunk Farleigh water while visiting an area supplied with that water. But regarding most of the cases in the Boarley and Cossington areas, no evidence was given either for or against this hypothesis. It is therefore impossible to decide whether they had contracted the fever in this way, or, as suggested by the Water Company, in other ways.

The second contention is, in our judgment, in the main a just one. Probably, the 10th of October is too early a date to lay down as the limit of extension of influence of the Farleigh water supply, in view of the time occupied by the distribution of the water, the incubation of the disease, and the sufficient development of its symptoms to permit its recognition and notification. It has also to be borne in mind that the evidence given at the inquiry was not such as to prove that the water of the Big Church spring may not have had some share in the causation of the epidemic; nor did it clearly appear that the Ewell springs were beyond suspicion. Water, however, from both these sources continued to be supplied to Maidstone during four days after the rest of the Farleigh springs had been cut off. But nearly all the cases notified after the 18th of October (some 280 in number) are to be regarded as having had a cause other than consumption of Farleigh water. By Mr. M. A. Adams they were referred to direct infection from previous cases, and to unsanitary conditions of water-closets, drains, and sewers. This explanation appears to us to be the probable one, if the unsanitary conditions referred to be taken in the wide sense of including the fouling of the soil by leakage from these defective drains and sewers. Recent researches into the life-history of the bacillus of typhoid fever go to show that this organism finds in a soil contaminated with foul matters from leaky sewers, drains, and cesspools, conditions especially favourable to its vitality and multiplication. That the soil on which Maidstone stands is thus contaminated was set beyond doubt by the evidence put before us. To the existence of these conditions is mainly, we consider, to be attributed the remarkable persistence of fever in Maidstone after the primary cause of the outbreak had been removed by cutting off the Farleigh water supply.

The third contention of the Water Company is probably in some degree admissible. Infection, however, from polluted soil and from defective water-closets and drains, being consequent on their first receiving infective material, cannot have played other than a subordinate part in the earlier stages of the epidemic. Be this as it may, we are of opinion that many of the cases of typhoid fever in the borough of Maidstone were due to defects of drainage and sewerage, with consequent pollution of the soil underlying the town. The responsibility for the existence of these unsanitary conditions lies with the Town Council, whose duty it was to take steps that would lead to effective remedy of these defects. This duty they have in large measure neglected; notwithstanding that for many years the Medical Officer of Health has in the plainest language repeatedly warned them of the risks to which the health of the inhabitants of the borough was exposed, by the continuance of these unsanitary conditions. The Town Council, therefore, cannot plead ignorance of the facts by way of excuse for their failure of duty in this respect—a failure of duty which has led to the gravest consequences.

It does not appear that the exceptional prolongation of the epidemic was in any way due to any subsequent laxity of administration; for as soon as it became evident that the epidemic was serious, the Sanitary Authority displayed the utmost energy and resource in dealing with it. Some doubt was expressed as to whether the Water Company had been sufficiently prompt in cutting off all the sources of the Farleigh supply when requested to do so by the Sanitary Authority. It appears to us that there was some unnecessary delay before the Big Church and Ewell springs were cut off from the town; but it must be remembered that the position of the Directors of the Water Company was a difficult one, having regard to their obligations to provide a sufficient supply of water for all purposes. In all other respects there was no hesitation on the part of the Directors in carrying out every recommendation of the Town Council; and their appointment of Dr. Sims Woodhead to investigate the cause of the outbreak and to act as their sanitary adviser was made unconditionally. The Emergency Committee of the Corporation, acting under the advice of Mr. M. A. Adams, and indefatigably assisted by Mr. L. Monckton, organized a most complete system of hospitals, medical attendance, and district nursing, and made arrangements for the washing and disinfecting of the infected clothes and bedding, which were carried out most efficiently, and on a scale which we believe has never before been attempted. The current sanitary work, the cleansing and flushing of the sewers, the disinfection of the houses, and the removal of the patients was most energetically superintended by the Sanitary Committee, under the chairmanship of Mr. Spencer.

We have already called attention to the fact that Mr. M. A. Adams did not consider it to be part of his duty, as Medical Officer of Health, to make inspections of the works of the Water Company which were outside his district, and that, in fact, he had never seen the Farleigh springs. In his capacity of County Analyst, he was paid by the Sanitary Authority for making periodical analyses of the four water supplies belonging to the Company and to the borough; but he was not instructed to analyze the various springs separately. Seven years ago the Town Council, influenced apparently by motives of economy, decided that these analyses should be made every quarter instead of every month as before; and their action in this respect has given rise to much unfavourable comment. As to this it may be remarked that, although frequent chemical analyses and bacteriological examinations may, by comparison of their results, show changes in the constituents of water, which may serve as a useful warning of liability to pollution, yet they by no means constitute all, nor indeed the chief, measures that should be adopted with a view of ascertaining the quality of water supplies. For the specific pollution of typhoid fever, which is certainly beyond the reach of chemistry, and generally, it would seem, also of bacteriology, to detect, may escape detection in a water in which it is nevertheless present. Further, it has to be borne in mind that detection of specific pollution of a supply may come too late to prevent the consumption of the contaminated water. Clearly chemical analyses and bacteriological examinations should be supplemented by skilled inspections of the actual conditions, geological, topographical, and sanitary, of the surroundings of the sources of supply.

While, on the one hand, the Sanitary Authority of Maidstone only took a precaution which was in its nature inadequate for the protection of the public health in its relation with the water supply of the borough, the Water Company, on the other, do not appear to have realized in any way the necessity of a constant and regular supervision either of the gathering-grounds of their supply or of its purity. Before a spring was brought into the supply, the water was analyzed by Dr. Gregory on behalf of the Company; and when complaints were made that any spring was polluted, it was cut off. But, generally speaking, the Directors relied on the quarterly analyses made by Mr. M. A. Adams; and there was never any systematic inspection of the works from a sanitary point of view. Apart from all question as to the possible means of protecting underground

supplies in this geological formation, the evidence clearly showed that, occasionally at least, the condition of the surroundings of some of the Farleigh springs was obviously and abominably filthy. There could have been nothing exceptional in this state of things, which must naturally result periodically from the aggregation of labourers on the hop and fruit farms at certain seasons of the year; and it could not possibly have escaped attention if there had been any attempt on the part of the Directors to secure not merely the safety, but the decent cleanliness, of the water supply by means of a regular inspection of the condition of the gathering-grounds. The importance of the matter never seems to have occurred to them.

The history of the epidemic at Maidstone appears to us to raise the question as to how far the regulations of the Board relating to the duties of Medical Officers of Health, and the statutes which regulate the powers and obligations of private water companies, are sufficient to ensure a reasonable amount of protection to the public health. The General Order of the Board of 1891 prescribes that the Medical Officer of Health "shall inform himself, as far as may be practicable, respecting all influences affecting or threatening to affect injuriously the public health within the district." This regulation might be held to make it the duty of the Medical Officer to visit and inspect the works of a private water company supplying water to his district, even though the works were situated outside it, as is the case at Maidstone. This, however, was not the construction which was put upon the regulation by Mr. M. A. Adams, whose zeal in the performance of his duties is beyond question; and, as a matter of fact, he had never seen the sources of the water supply furnished to the Farleigh area. He pointed out with considerable force that he had no legal right of access to the works, and no power to take samples of the water. The Medical Officer of the Rural Authority would have to meet the same difficulty as to the right of access to the works and as to taking samples of the water, although the works are locally situated in his district, a very small part of which is supplied with water by the Company. Yet section 7 of the Public Health (Water) Act, 1878, imposes upon Rural Sanitary Authorities the duty of taking such steps as may be necessary to ascertain the condition of the water supply within their district. It must be stated, however, that it did not appear that any application to inspect the works or to take samples of the springs separately was ever made to the Directors of the Water Company by either of the Sanitary Authorities concerned.

As we have already reported, a question arose during the course of the epidemic between the Town Council and the Water Company as to the necessity of cutting off certain of the suspected springs. This measure was recommended by the Medical Officer of Health. But the Town Council had no power to carry it out; and the Directors hesitated to take the responsibility of diminishing the supply of water for general purposes. The delay which resulted from this cause was short; but it is clear that, under less fortunate circumstances, such a difference might lead to the most serious results.

In conclusion, we have to report that we received every assistance, both from the Town Council and from the Water Company, who gave us without reserve, all the information in their power. In addition, our thanks are especially due to Mr. L. Monckton, who spared no pains to help in every possible way; to Mr. M. A. Adams, under whose supervision the diagrams annexed to this report were prepared; to Mr. Percy Adams; and to Mr. Ware, the Manager of the Water Company.

The correspondence that passed between the Local Government Board and the authorities of the borough and others on the subject of the epidemic is set forth in appendices attached to the report. Copies of the many different water analyses, chemical and bacteriological, made by order of the Town Council, are also given, and statistics are quoted which show the extent of the epidemic within the borough. The total number of typhoid cases was 1847, of which 132 were fatal; the total mortality being 7·14 per cent.

## NOTES FROM SCOTLAND.

**From Our Own Correspondent.**

*Saturday.*

In connection with the valuation of the Falkirk Gas-Works, to which I referred last week, I may mention that on Tuesday night a meeting of the Corporation was held, at which the Clerk intimated that he had, as instructed, applied to the owners of the gas-works at Stirling, Dumbarton, and Alloa, for a statement of the valuation put upon their works. He had received answers from all; but in the reply from Dumbarton it was stated that the information was for private use only, so that he could not give them the exact valuation. He might say, however, that in none of the three burghs were the gas-works valued at as much as one-half of the amount which the Falkirk works were valued at. The valuations were all under £2000; whereas the valuation of the Falkirk works was over £4000. The Assessor, the Clerk said, fixed his valuation on the revenue and the expenses (the profits I suppose he meant to say); and this brought out the remark, from the Convener of the Works Committee, that he thought the Assessor was wrong. Of course, the Assessor is not wrong in following this rule. He may be wrong in his application of the rule—as to that I have no information; but the rule is well established, and is recognized everywhere. What the Corporation of Falkirk have to learn is how to work so as not to make such a profit as will raise the valuation of their works. That is quite legitimate.

Since the Glasgow Corporation Gas Committee commenced to work their stove-hiring department, they have done a big business in the hire and sale of gas-stoves, &c.; but it might have been greater. The last return prepared by Mr. W. Foulis shows that in the hiring business the transactions amounted to 14,149, including stoves and range fittings. In the sales business, however, a much larger trade was done. Including stoves, range fittings, fires, burners, &c., the number disposed of amounted to 22,724. It may be possible later on to make a very material increase to the business in both branches—that is to say, when the purchase and sales of stoves, &c., have been brought nearer to the houses of the gas consumers.

At the last meeting of the Glasgow Corporation Sub-Committee on Gas

## GAS AND WATER COMPANIES STOCK AND SHARE LIST.

**Referred to on p. 688.**

| Issue. | Share. | When ex-Dividend. | Dividend or Dividend & Bonus. | NAME. | Closing Prices. | Rise or Fall in Wk. | Yield upon Investment. |
|---|---|---|---|---|---|---|---|
| £ | | | p. c. | GAS COMPANIES. | | | £ s. d. |
| 590,000 | 10 | Apl. 15 | 10½ | Alliance & Dublin 10 p. c. | 22½—23½ | .. | 4 9 4 |
| 100,000 | 10 | ,, | 7½ | Do. 7 p. c. | 16½—17½ | .. | 4 5 9 |
| 300,000 | 100 | July 1 | 5 | Australian 5 p. c. Db. . | 105—107 | .. | 4 13 6 |
| 200,000 | 5 | May 26 | 6 | Bombay, Ltd. . . . | 6½—7 | .. | 4 5 9 |
| 40,000 | 5 | ,, | 6 | Do. New, £4 paid . | 4½—5 | .. | 4 16 0 |
| 880,000 | Stk. | Aug. 12 | 12 | Brentford Consolidated | 275—280 | .. | 4 5 9 |
| 240,000 | ,, | ,, | 9 | Do. New . . . . | 210—215 | .. | 4 3 9 |
| 50,000 | ,, | ,, | 5 | Do. 5 p. c. Prf.. . | 140—145 | .. | 3 9 0 |
| 159,375 | ,, | June 10 | 4 | Do. 4 p. c. Db. Stk. | 130—135 | .. | 2 19 3 |
| 220,000 | Stk. | Sept. 15 | 11½ | Brighton & Hove Orig.. | 262—267* | .. | 4 6 2 |
| 226,320 | ,, | ,, | 8½ | Do. A. Ord. Stk. . | 190—195* | .. | 4 7 2 |
| 933,500 | Stk. | Aug. 31 | 5 | Bristol, 5 p. c. max. . . | 125—130 | .. | 3 16 11 |
| 420,000 | 20 | Mar. 30 | 10† | British . . . . . | 51—53 | .. | 3 15 6 |
| 50,000 | 10 | Aug. 12 | 11½ | Bromley, Ord. 10 p. c. . | 25—27 | .. | 4 5 2 |
| 75,000 | 10 | ,, | 8½ | Do. 7 p. c. . | 20—22 | .. | 3 17 3 |
| 500,000 | 10 | Apl. 29 | 6 | Buenos Ayres (New) Ltd | 9—9½ | .. | 6 6 4 |
| 98,122 | Stk. | June 29 | 4 | Do. 4 p. c. Db. Stk. | 98—100 | .. | 4 0 0 |
| 150,000 | 20 | July 14 | 8½ | Cagliari, Ltd. . . . | 29—30 | .. | 5 10 0 |
| 100,000 | 10 | June 10 | 7 | Cape Town & Dis., Ltd. | 15—16 | .. | 4 7 6 |
| 50,000 | 50 | May 3 | 6 | Do. 6 p. c. 1st Mort. | 58—60 | .. | 5 0 0 |
| 550,000 | Stk. | Apl 15 | 13½ | Commercial Old Stock . | 315—325 | .. | 4 3 1 |
| 200,750 | ,, | ,, | 10½ | Do. New do. . . | 252—257 | .. | 4 1 8 |
| 200,750 | ,, | June 10 | 4½ | Do. 4½ p. c. Db. do. | 148—153 | .. | 2 18 10 |
| 800,000 | Stk. | June 10 | 12 | Continental Union, Ltd. | 307—312 | .. | 5 13 2 |
| 200,000 | ,, | ,, | 9 | Do. 7 p. c. Prf. . | 193—198 | −4 | 4 10 11 |
| 51,600 | Stk | Aug. 31 | 14 | Croydon A 10 p. c. . . | 305—310 | .. | 4 10 4 |
| 168,400 | ,, | ,, | 11 | Do. B 7 p. c. . . | 255—265 | .. | 4 3 0 |
| 555,000 | Stk. | Aug. 12 | 5½ | Crystal Palace Ord. 5 p. c. | 125—130 | .. | 4 0 9 |
| 60,000 | ,, | ,, | 5 | Do. 5 p. c. Prf. . | 140—145 | .. | 3 9 0 |
| 486,090 | 10 | July 28 | 11 | European, Ltd. . . . | 23—24 | .. | 4 11 8 |
| 354,060 | 10 | ,, | 11 | Do. £7 10s. paid . | 17—18 | .. | 4 11 9 |
| 5,922,230 | Stk. | Aug. 12 | 12½ | Gaslight & Coke, A, Ord | 292—297 | +1 | 4 2 6 |
| 100,000 | ,, | ,, | 4 | Do. B, 4 p. c. max. . | 120—125 | .. | 3 4 0 |
| 665,000 | ,, | ,, | 10 | Do. C, D, E, 10 p. c. Prf. | 305—310 | .. | 3 4 6 |
| 30,000 | ,, | ,, | 5 | Do. F, 5 p. c. Prf. . | 152—157 | .. | 3 3 8 |
| 60,000 | ,, | ,, | 7½ | Do. G, 7½ p. c. do. . | 230—240 | .. | 3 2 6 |
| 1,300,000 | ,, | ,, | 7 | Do. H, 7 p. c. max. . | 195—200 | .. | 3 10 0 |
| 463,000 | ,, | ,, | 10 | Do. J, 10 p. c. Prf. . | 305—310 | .. | 3 4 6 |
| 476,000 | ,, | ,, | 6 | Do. K, 6 p. c. Prf. . | 182—187 | .. | 3 4 2 |
| 1,061,150 | ,, | June 10 | 4 | Do. 4 p. c. Db. Stk. . | 131—133 | .. | 3 0 2 |
| 294,850 | ,, | ,, | 4½ | Do. 4½ p. c. do. . | 148—153 | .. | 2 18 10 |
| 958,000 | ,, | ,, | 6 | Do. 6 p. c. do. . | 198—203 | .. | 2 19 1 |
| 70,000 | 10 | May 12 | 8 | Hongkong & China, Ltd. | 14—15 | .. | 5 6 8 |
| 3,800,000 | Stk. | ,, | 10 | Imperial Continental . | 218—223 | .. | 4 9 8 |
| 376,400 | 100 | Aug. 2 | 4 | Do. 4 p. c. Dbs. Red. | 98—101 | .. | 3 19 8 |
| 473,600 | Stk. | Aug. 12 | 3½ | Do. 3½ p. c. Db. Stk. ,, | 101—104 | .. | 3 7 4 |
| 560,000 | 100 | Apl. 1 | 5 | Met. of Mel- bourne } 5 p. c. Db. | 111—113 | .. | 4 8 10 |
| 250,000 | 100 | ,, | 4½ | } 4½ p. c. Db. | 107—109 | .. | 4 2 7 |

* Ex div.

| Issue. | Share. | When ex-Dividend. | Dividend or Dividend & Bonus. | NAME. | Closing Prices. | Rise or Fall in Wk. | Yield upon Investment. |
|---|---|---|---|---|---|---|---|
| £ | | | p. c. | GAS COMPANIES. | | | £ s. d. |
| 75,000 | 5 | June 29 | 6 | Malta & Medn., Ltd. . | 4¾—5¼ | .. | 5 14 3 |
| 541,920 | 20 | June 10 | 5 | Monte Video, Ltd. . . | 13½—14½ | .. | 6 18 0 |
| 617,946 | Stk. | Aug. 31 | 9¾ | Newc'tle & Gatesh'd Con. | 236—240 | .. | 4 1 3 |
| 252,355 | Stk. | Jan. 3 | 3½ | Do. 5½ p. c. Db. Stk. | 113—117 | .. | 2 19 10 |
| 150,000 | 5 | May 26 | 8 | Oriental, Ltd. . . . | 7¼—8 | .. | 5 0 0 |
| 135,000 | 5 | ,, | 8 | Do. New, £4 10s. pd. | 6¼—7 | .. | 5 2 11 |
| 15,000 | 5 | ,, | 8 | Do. do. 1879, £1 pd. | 1½—1¾ | .. | 4 11 5 |
| 60,000 | 5 | Mar. 11 | 7 | Ottoman, Ltd. . . . | 5—5½ | .. | 6 6 2 |
| 500,000 | 100 | June 1 | 6 | People's Gas } 2nd M. of Chicago } Bd. . | 103—108 | .. | 5 11 1 |
| 848,070 | 10 | May 26 | 6 | River Plate Ord.. . . | 9½—9¾ | .. | 6 3 1 |
| 250,000 | Stk. | June 29 | 4 | Do. 4 p. c. Db. Stk. | 99—101 | .. | 3 19 3 |
| 250,000 | 10 | Apl. 29 | 10 | San Paulo, Ltd. . . . | 15—16 | .. | 6 5 0 |
| 135,000 | Stk. | Sept. 15 | 10 | Sheffield A. . . . . | 243—245* | .. | 4 1 8 |
| 309,053 | ,, | ,, | 10 | Do. B. . . . . | 242—245* | .. | 4 1 8 |
| 447,427 | ,, | ,, | 10 | Do. C. . . . . | 242—245* | .. | 4 1 8 |
| 5,600,000 | Stk. | Aug. 12 | 5½ | South Metrop., 4 p.c. Ord. | 140—143 | .. | 3 14 7 |
| 1,460,000 | ,, | July 14 | 3 | Do. 3 p. c. Db. Stk. . | 101—104 | .. | 2 17 8 |
| 60,000 | Stk. | Aug. 31 | 12 | Tottenham and } A. . | 280—290 | .. | 4 2 9 |
| 60,000 | ,, | ,, | 9 | Edmonton } B. . | 200—210 | .. | 4 5 9 |
| 182,380 | 10 | June 10 | 7 | Tuscan, Ltd. . . . . | 10¼—11¼ | .. | 6 1 9 |
| 149,900 | 10 | July 1 | 5 | Do. 5 p. c. Dbs. Red. . | 100—103 | .. | 4 17 1 |
| | | | | WATER COMPANIES. | | | |
| 746,164 | Stk. | June 29 | 10½ | Chelsea, Ord. . . . . | 313—318 | .. | 3 6 0 |
| 150,000 | ,, | ,, | 5 | Do. 5 p. c. Prf. . . . | 170—175 | .. | 2 17 2 |
| 160,000 | ,, | ,, | 4½ | Do. 4½ p.c. Pf. Stk., 1875 | 148—152 | .. | 2 19 3 |
| 175,785 | ,, | Mar. 30 | 4½ | Do. 4½ p. c. Db. Stk. . | 157—162 | .. | 2 15 7 |
| 1,720,560 | Stk. | Apl. 15 | 8 | East London, Ord. . . | 212—217 | −1 | 3 13 9 |
| 654,740 | ,, | June 29 | 4½ | Do. 4½ p. c. Db. Stk. | 157—160 | .. | 2 16 3 |
| 390,000 | ,, | ,, | 3 | Do. 3 p. c. Db. Stk.. | 103—105 | .. | 2 17 2 |
| 700,000 | 50 | June 29 | 7½ | G'd Junct'n, 10 p. c. max. | 115—118 | .. | 3 3 7 |
| 310,000 | Stk. | Mar. 30 | 4 | Do. 4 p. c. Db. Stk. | 142—147 | .. | 2 14 5 |
| 708,000 | Stk. | Aug. 12 | 14 | Kent . . . . . | 364—369 | .. | 3 15 11 |
| 160,000 | ,, | ,, | 7 | Do. New, 7 p. c. max.. | 212—217 | .. | 3 4 6 |
| 1,043,800 | 100 | June 29 | 10 | Lambeth, 10 p. c. max.. | 298—303 | .. | 3 6 0 |
| 406,200 | 100 | ,, | 7½ | Do. 7½ p. c. max.. | 227—232 | .. | 3 4 8 |
| 350,000 | Stk. | Mar. 30 | 4 | Do. 4 p. c. Db. Stk. | 140—145 | .. | 2 15 2 |
| 500,000 | 100 | Aug. 12 | 13½ | New River, New Shares | 432—437 | .. | 3 0 7 |
| 1,000,000 | Stk. | July 28 | 4 | Do. 4 p. c. Db. Stk. | 140—145 | .. | 2 15 2 |
| 902,300 | Stk. | June 29 | 6 | Southw'k & V'xhall, Ord. | 164—169 | −2 | 3 11 0 |
| 126,500 | 100 | ,, | 6 | Do. do. 7½ p. c. max.. | 157—162 | .. | 3 14 1 |
| 489,200 | Stk. | ,, | 5 | Do. do. 5 p. c. Prf. . | 168—172 | .. | 2 18 2 |
| 1,019,585 | ,, | Apl. 15 | 4 | Do. 4 p. c. A Db. Stk. | 141—144 | .. | 2 15 7 |
| 1,155,056 | Stk. | June 10 | 10 | West Middlesex . . . | 300—305 | .. | 3 5 7 |
| 200,000 | ,, | ,, | 4½ | Do. 4½ p. c. Db. Stk. | 162—165 | .. | 2 14 7 |
| 200,000 | ,, | Sept. 15 | 3 | Do. 3 p. c. Db. Stk. | 102—105* | .. | 2 17 2 |

* Ex div.

† Next dividend will be at this rate.

Finance, the Treasurer (Mr. Fleming) reported on the collection of the gas-rents outstanding as at the 31st of May, when the balance was struck for the year 1897-8. At that date, it was calculated that there was still outstanding a sum of £68,578; and when the report was brought before the Finance Sub-Committee, it was stated that there had been collected to date a sum of £67,027; so that there was a balance still outstanding amounting to £1550. Of course this amount is decreasing every day. At the same date Mr. Fleming reported that for the new year, 1898-9, there had been collected a sum of £2333; while at the same date in the preceding year it was £1557; thus showing for the current year an increase amounting to £776. The current collecting term is one of six months, extending to the end of November; the other collecting terms are periods of three months each.

All danger of the chimney at the Edinburgh Gas-Works falling is now past. When I saw it this afternoon, there was only about 12 feet of the brickwork standing. Below that is a square stone base, about 20 feet in height. In other two weeks, probably, the whole will be removed. The work has been very expeditiously gone about, and without accident. Curiously enough, a chimney is also being taken down at the Stirling Gas-Works. A new retort-house is being built; and in connection with it a chimney has been erected, a short distance from the old one, and a good deal smaller than it. When I saw the place this week, the old chimney was in process of demolition; the top half of it having been already removed. The first section of the new retort-house has been completed. It is a lofty and commodious building.

Another death has resulted from the accident at the works of the Scottish Cold Storage and Ice Company, Glasgow, to which reference was made in the "JOURNAL" last week. Thomas Graham, a compressor, died on Monday night in the Glasgow Infirmary. At a special meeting of the Company held that day, the Chairman (ex-Bailie Simons) made a statement to the representatives of the Press at the close of the proceedings, in the course of which he said: "It is a mistake to suppose that there was any explosion at the George Street works on Saturday afternoon. Not a pane of glass or an electric lamp was broken, and there was no report. The accident is entirely attributable to the bursting of an iron pipe, through which the ammonia was conveyed from one part of the system to another, just as any ordinary gas, water, or steam pipe might have burst. The pipe in question was subjected by the manufacturer to a hydraulic test pressure equal to 700 lbs. on the square inch, which was considered ample, as that is considerably more than double what it would be subjected to in connection with plant working in normal conditions. An examination of the pipe showed that a piece was blown out in the side at what is known as a knee—a bend of that shape—but how this occurred in the case of such a strong pipe still remains a mystery."

The Glasgow water-pipe contract has passed through another phase. Last week the Corporation resolved to divide the contract between Messrs. R. MacLaren and Co., of Glasgow, and Messrs. R. D. Wood and Co., of Philadelphia. The division was made as to sizes; and its effect was to give about two-thirds of the whole to the Glasgow firm, and one-third to the American firm. Messrs. MacLaren would not agree to the division. They wrote that their quotation was an overhead one; and that before they would consent to accept a portion of the order, they would require to raise their price by 13s. per ton. After this communication, the Water Committee met and resolved to give the whole of the contract to the American firm.

The Edinburgh and District Water Trust, on Friday of last week, made an inspection of their new works in the Talla Valley. These were found to be making good progress in the hands of Messrs. Young and Sons, the Contractors. When on the spot, the Trustees directed their attention to two subjects. One was the proposal, which has been mooted, to construct a bank at the upper end of the reservoir. The object of making the bank is to avoid the laying bare of a large area of ground in dry weather, upon which vegetable matter would grow, and would be again submerged. The embankment would be so constructed as to give a depth of 10 feet of water at the edge of the loch, at which depth vegetation does not flourish. It is estimated that the construction of the bank would cost £9000. The Trustees are to consider the matter. The other subject had reference to the nature of the bed of the reservoir. Mr. Baxter, a Leith representative, had made the allegation that there was bog, or peat, in great quantity, which would require to be cleared out, at a probable cost of £200,000; or that, if left, it would contaminate the water. The statement was contradicted; and Mr. Baxter was asked to point out where the peat was. This he was unable to do, though he kept the company wandering over the place till there was scarcely time for dinner. The truth is that the bed of the Talla Valley is, like nearly every other valley, composed of soft material which has been washed down from the surrounding hills. It is not peat, however, and will not discolour the water. The Contractors are bound to strip off the vegetation, if required; and should this be done, the bed of the reservoir will be like that of any natural loch—neither better nor worse.

The Falkirk and Larbert Water Trust had a revenue last year of £7627, and an expenditure of £7025; leaving a balance of £602. A year ago the domestic rate was reduced from 1s. to 10d. per pound, and the shop rate from 7d. to 5d. per pound. As a consequence the revenue from the rates was £3501, as compared with £3769—a decrease of £268. But for the reduction of the rates, there would have been an increase of about £250. During the year £3830 was expended upon new works, and £3755 upon extensions to the distributing plant.

**The Expenses of the Maidstone Typhoid Epidemic.**—A letter has been received at Maidstone from the Local Government Board, stating that a loan to cover the expenses incurred by the Town Council in connection with the epidemic of typhoid fever which occurred in the borough last autumn can only be granted for three years. The Council had applied for sanction to borrow £18,000, and to spread the repayments over twenty years. The Local Government Board intimate that they are disposed to grant a loan of £15,000 only. This decision, both as to the amount and the period of the loan, has caused great surprise in the borough, to which it means an annual rate of 1s. in the pound for the three years.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**Greater Variety than any other Maker.**

**All Parts Rapidly and Cheaply Replaced.**

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# JOHN WRIGHT & CO., Ltd.,

*LONDON AND BIRMINGHAM.*

## CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Sept.* 24.

**Sulphate of Ammonia.**—The market has again been in a lifeless condition; and there has been a further decline in values—the closing quotations being £9 17s. 6d. to £10 per ton, delivered f.o.b. at the ports. The spot market has been mainly in the hands of the dealers; and the buying has for the most part been for covering sales for September delivery. Consequently, the firmer tone at the close of last week quickly disappeared; and parcels offered could only be disposed of at a decline. But again there is more inquiry, without, however, any improvement in prices. Consumers have given more attention to October or October-December delivery. But their ideas are to buy at a substantial discount, or else to postpone their purchasing until a larger production becomes available; and, as a consequence, their operations have not been on a large scale. Meantime makers' quotations in the forward position are altogether unchanged.

**Nitrate of Soda** is a shade easier; and 7s. 6d. per cwt. is the nearest value of fine quality on spot.

LONDON, *Sept.* 24.

**Tar Products.**—A somewhat slack market characterizes the position of the week. Very low prices are being accepted in some positions for crude naphtha; Scotch crude having been sold at a shade over 2¾d. per gallon, while English naphtha has been done at 4½d. per gallon, casks included. There is a little more inquiry for heavy naphthas, with special fractions; but benzols and solvent are neglected—buyers seeming to take no interest in the market. The advent of German benzol and naphtha is a disquieting feature; and buyers are anxious to know how far this will extend. The commencement of the pitch shipping season has made makers busier at their works. Anthracene is unsaleable; and prices quoted are nominal.

To-day's values are: Tar, 14s. to 18s. 6d. Pitch, east coast, 25s.; west coast, 23s. Benzols, 90's and 50's, 9d. Toluol, 1s. 2d. Solvent naphtha, 1s. 2d. Heavy naphtha, 1s. 2d. Crude, 30 per cent., naphtha, 3½d. Creosote, 2½d. Heavy oils, 47s. Carbolic acid, 60's, 1s. 11d. Naphthalene, 55s.; salts, 30s. Anthracene, "A," 4d.; "B," 3d.

**Sulphate of Ammonia.**—This market has lacked briskness of late; and there are buyers at a shade below quotations. Whether the present lull is due to the action of dealers, or it may be buyers are taking breath after the recent spurt, will soon be seen. Producers have no stocks; and very few makers are offering at any price. The little business that has transpired has realized £9 16s. 3d. to £9 18s. 9d. per ton, less 3½ per cent., which is the value at most ports.

## COAL TRADE REPORTS.

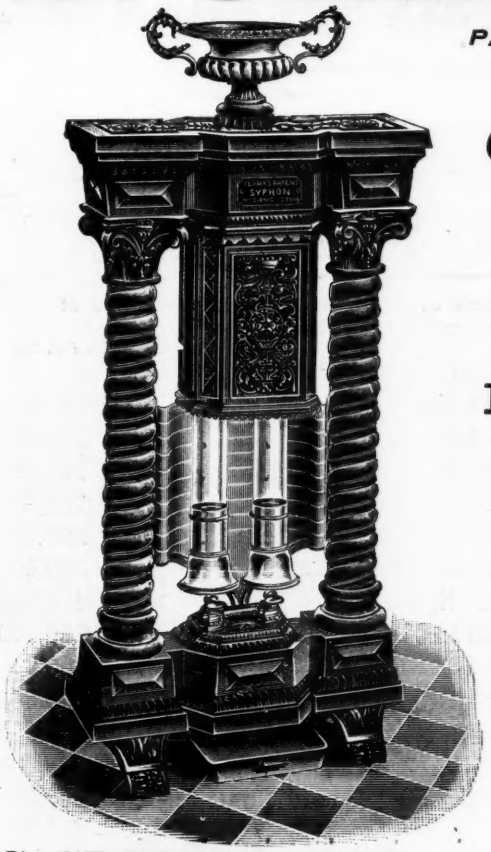
**From Our Own Correspondents.**

**Lancashire Coal Trade.**—The chief matter just now occupying attention in the coal trade is the wages question; but though there would seem to have been a considerable amount of apprehension in some quarters of possible trouble between the federated coalowners and the Miners' Federation—which has resulted in some extra buying during the past week or so—the probabilities are that the whole matter will be amicably arranged at the joint conference that is being held this week. The better qualities of round coal are beginning to move away rather more freely, for house-fire purposes; but the demand is still limited for the time of the year. Though the principal Lancashire collieries are holding firmly to their advances, there is some irregularity as regards prices in the open market. Common round coals continue in generally brisk demand; and collieries have not only no difficulty in moving away all their output, but are readily able to obtain their full prices. Engine classes of fuel are generally in fairly active request. But in some qualities of slack there are plentiful supplies offering from outside districts; and large buyers are in many cases temporarily transferring business where collieries are demanding the full advance, which, however, is not in all cases being strictly adhered to. Quoted prices average 11s. to 11s. 6d. per ton at the pit for best round coals; 9s. 6d. to 10s. 6d., for seconds; 7s. 6d. to 8s. 6d., for common; 4s. 9d. to 5s. 3d., for best engine fuel; 4s. 3d. to 4s. 6d., for medium; and 3s. 6d. to 3s. 9d., for common sorts. The shipping trade has quietened down; but a good many collieries have still orders on their books, on which deliveries are not yet completed. Prices are steady at about 9s. 6d. to 9s. 9d. per ton for ordinary qualities, delivered at Mersey ports. Coke is becoming scarce in the market, with a steady hardening up in prices; and many of the iron-works are just now experiencing considerable difficulty in placing contracts for their forward requirements.

**Northern Coal Trade.**—The fall in the price of coal in this district has continued; but it is chiefly marked in steam and bunker qualities. There is now a keener competition among steam coal owners; and weaker prices are the result. Best Northumbrian steam coals are in good demand, but have fallen to about 10s. per ton f.o.b. Second qualities are about 9s. 3d. per ton; and steam smalls, 6s. In the gas coal trade, there is still a heavy inquiry; and for quantities that are not contracted for, higher rates have had to be paid. Heavier deliveries are now taking place on contracts; and thus the large output is taken up, and will be increasingly pressed for as the winter season enlarges consumption. For occasional cargoes, from 10s. to 11s. per ton is asked. In manufacturing coals there is little or no alteration. Good unscreened bunker coals may be had at about 9s. per ton free on board. Gas coke is in fuller request, and prices are stronger, though there is no quotable advance. Exports of gas coke seem more frequent, and there is thus a lessened stock generally.

**Scotch Coal Trade.**—The demand for all sorts of coal continues to be good; and prices for immediate delivery are almost unaltered. For forward delivery, there is a slight fall in price. The current quotations are: Main, 9s. to 9s. 3d. per ton f.o.b. Glasgow; ell, 10s. to 10s. 6d.; and splint, 10s. to 10s. 3d. The shipments for the week were 241,605 tons—an increase of 6240 tons upon the previous week, and of 70,255 tons upon the corresponding week of last year. For the year to date, the total shipments have been 7,054,115 tons—an increase upon the same period of last year of 1,342,261 tons.


# S. CLARK & CO.,

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Especially suitable for—
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*WRITE FOR NEW SEASON'S CATALOGUE.*

**S. CLARK & CO., Syphon Works, PARK ST., ISLINGTON, LONDON, N.**

**Water Divining in Egypt.**—Mr. Gataker, the water-diviner, is making a tour in Egypt in search of water; and the first result of his work has just been made known. An artesian well has been bored near Alexandria, at a spot indicated by him, to a depth of 350 feet, at which depth a yield of 40 gallons a minute has been secured—the water rising 4 feet above the ground-level. Mr. Gataker predicted that the water would be found at a depth of from 300 to 500 feet.

**The Differences in the Charges for Gas at Hull.**—Now that one of the gas undertakings has passed into the hands of the Hull Corporation, the public are gradually becoming acquainted (says the "Hull News") with some of the anomalies that exist with regard to street lighting, and the difference in price charged to the gas consumers by the three concerns. So far as regards the Old Town, the charge is £3 12s. for each ordinary street-lamp per annum, with a price of 3s. per 1000 cubic feet to consumers. The Sutton and Southcoates Company charge £3 0s. 6d. per lamp, and 2s. 3d. per 1000 cubic feet; while the British Gaslight Company fix the prices at £2 11s. 6d. and 1s. 10d. respectively. These anomalies, in the opinion of our contemporary, are not likely to be removed until the Corporation have the entire lighting of the town in their own hands.

**Sales of Stocks and Shares.**—On Thursday last, Messrs. Blake and Carpenter disposed, in 30 lots, of £735 of stock of the Croydon Gas Company, at the following prices: Four lots of £25 consolidated "A" ordinary stock, £86 10s. each; two similar lots, £86 5s. each; and one, £86. Two lots of £20 of similar stock fetched £67 10s. each; fifteen lots of £25 of consolidated "B" ordinary stock, £68 5s. apiece; and three lots, £68 each; while £20 of the stock was sold for £54 15s. On the same day, Messrs. West, Usher, and Co. sold at Deal five original shares of £10 each in the Hythe and Sandgate Gas Company for £36 5s. each; five similar shares realizing £35, and four others £29 10s. apiece. In the evening, Messrs. J. Crampton and Son offered for sale, at the Swan Hotel, Mansfield, £1000 of 4 per cent. gas debenture stock of the Mansfield Corporation; and it was disposed of at £109 and £111 per £100 lot.

**Proposal to Purchase the Ibstock Gas-Works.**—At a recent meeting of the Market Bosworth District Council, Mr. Hextall moved that application be made to the Local Government Board for powers to enable the Parish Council of Ibstock to purchase, and the Company to sell, their works. He said the purchase of the works would be for the best interests of the parish. The ratepayers could not sustain any loss, because the Gas Company had in the past paid a good dividend. Mr. Bertwistle seconded, and said that, if the Council purchased the works, they would be able to sell cheaper gas; and the works would, therefore, be a greater success. The consumers were now paying 5s. 9d. per 1000 cubic feet. Mr. Thirlby said, if the scheme was carried out, it would entail an expenditure of something like £6000 or £7000. Mr. Bertwistle stated that it was misleading to say that the venture was to cost £7000. He knew himself that the Company had offered to sell the works for about a third of that sum. An amendment was passed to the effect that the feeling of the ratepayers on the subject should be ascertained before taking any further proceedings.

**A Water Scheme for Llangollen.**—The Llangollen District Council have passed a resolution recommending to the ratepayers a scheme of water supply propounded by Mr. Henry Rofe. It is estimated to cost £30,000.

**Hollingbourne Water Supply.**—The Local Government Board last Thursday informed the Hollingbourne Rural District Council that, after considering the report made by their Inspector on the inquiry recently held at Sutton Valence with reference to the Council's application for permission to borrow £500 for water purposes, they had decided to sanction the application with respect to £225 for extensions to the wells, and £150 for raising the tank. They, however, could not grant the £125 required for the mains until the Council had the water.

**American 'Cuteness in Pushing Trade.**—Messrs. Richmond and Co., Limited, have recently opened in Plymouth, in connection with the Plymouth Gas Company, a show-room for gas stoves and fittings. A few days ago, the American Consul called and inspected their goods, asked for lists, and then said that he believed his people could supply better value, and that he should write out to various makers of similar appliances in the States, and suggest their shipping a quantity of goods to compete with them. This instance of the alertness and business promptitude of American consuls was communicated by Mr. Richmond to the "Daily Mail," in which had appeared an article dealing with the subject of the decline of English trade. He very pertinently asked how many of our consuls would do as their American colleague had done. Mr. Richmond thinks the solution is to be found in having commercial attachés to the consulates. At all events, here is an example of 'cuteness which it might be well to follow, if, as he says, home manufacturers are to be kept "as much abreast of foreigners and as well informed on foreign openings as our American cousins are kept by their alert consuls."

**Torquay Gas Company.**—The half-yearly meeting of this Company was held on Wednesday last—Mr. W. H. Kitson presiding. The Chairman said there had been a considerable improvement in the affairs of the Company during the half year. The sale of gas to ordinary consumers had realized £9299, as compared with £8886 in the corresponding period of last year; and though there had been a falling off of £100 in the receipts for public lighting which brought in £750 instead of £850, the increase of £300 on the two items was very satisfactory. Meter-rents were £485, against £421. With regard to residual products, coke had realized £1973, as compared with £1611; tar had fallen off from £328 to £308; while the income from the sale of sulphate of ammonia had gone up from £126 to £306. The receipts from the three items were £2589, as against £2065. The hire of gas-stoves during the half year had brought in £127, as compared with £94. On the other side, the items varied very little. The total receipts for the half year were £13,441; and the total expenditure was £9929—leaving a balance of £3512, as against £3348 in the corresponding half of last year. The usual dividends would absorb £3396; and a balance of £116 would be carried forward. Twelve months ago, payment of the dividends involved a slight deficiency of £48. The motion that dividends of 10 and 7 per cent. be paid was carried.


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| | Cubic Feet Daily. |
|---|---|
| BLACKBURN | 1,250,000 |
| WINDSOR STREET WORKS, BIRMINGHAM | 2,000,000 |
| SALTLEY WORKS, BIRMINGHAM | 2,000,000 |
| COLCHESTER | 300,000 |
| BIRKENHEAD | 2,250,000 |
| SWINDON (New Swindon Gas Co.) | 120,000 |
| SALTLEY WORKS, BIRMINGHAM (Second Contract) | 2,000,000 |
| WINDSOR STREET WORKS, BIRMINGHAM (Second Contract) | 2,000,000 |
| HALIFAX | 1,000,000 |
| TORONTO | 250,000 |
| OTTAWA | 250,000 |
| LINDSAY (Remodelled) | 125,000 |
| ROCHESTER | 500,000 Cubic Feet. |

| | Cubic Feet Daily |
|---|---|
| TORONTO (Second Contract; Remodelled) | 2,000,000 |
| MONTREAL | 500,000 |
| BELLEVILLE | 250,000 |
| OTTAWA (Second Contract) | 250,000 |
| BRANTFORD (Remodelled) | 200,000 |
| ST. CATHERINES (Remodelled) | 250,000 |
| KINGSTON, PA. | 125,000 |
| PETERBOROUGH, ONT. | 250,000 |
| WILKESBARRE, PA. | 750,000 |
| ST. CATHERINES (Second Contract) | 250,000 |
| BUFFALO, N.Y. | 2,000,000 |
| WINNIPEG, MAN. | 500,000 |
| COLCHESTER (Second Contract) | 300,000 |
| YORK | 750,000 |

**The Maidstone Corporation and the Water-Works.**—The Maidstone Town Council last Wednesday decided to promote a Bill next session for the compulsory acquisition of the water-works, and the extension of the present sources of supply. The undertaking will cost about £120,000.

**Kingsbridge Water Supply.**—The inadequacy of the water supply is a continual subject of complaint and discussion at Kingsbridge. At the last meeting of the Urban District Council, numerous representations were made as to the low pressure and small yield from the mains; and the Council recommended that underground tanks should be made in certain cases, in which the water could be collected. A report was presented by Mr. E. Sandeman, the Water Engineer of the Plymouth Corporation, on means for improving the supply. Mr. Sandeman agrees with the Kingsbridge Surveyor that the most feasible scheme is to obtain water from the springs on the Borough Estate. The present supply is 36,000 gallons per day, and the springs are estimated to yield 28,800 gallons, which would be sufficient to meet the wants of the present population. He recommends the construction of a reservoir to hold 600,000 gallons; the estimated cost being £3850 without land or easements.

**Gas and Electric Lighting at Johannesburg.**—The Town Council of Johannesburg are issuing debentures to the amount of £150,000, a large portion of which is to be applied to the purposes of the Lighting Department. The works for the lighting of the city were acquired in 1895, since which year fair progress has been made. The quantity of electricity generated monthly has grown from 20,000 to 76,600 units; and the gas-making plant has also been greatly extended. The capacity of the gasholder has been increased from 65,000 to 150,000 cubic feet. About 3 million cubic feet of gas are manufactured monthly, as against about 1¼ millions three years ago. The Council have at present 600 electric current consumers and 388 gas consumers; whereas when the undertaking changed hands the former consumers only numbered 96, and the latter 287. The public lighting plant has increased from 104 to 435 gas-lamps, and from 19 to 684 electric incandescent lamps; while 47 arc lamps have been added. The private electric lamps in use and connected with the Council's mains are equal to 30,000 lamps of 8-candle power each, as against 5000 lamps when the concern was taken over. There are, however, still miles of streets either not lighted at all or lighted in the most inadequate manner.

**Cirencester Gas Company, Limited.**—At the annual meeting of this Company, held last Saturday, the Directors reported a steady increase in the sale of gas; the consumption during the year ending June having been nearly a million cubic feet in excess of any previous twelve months. The profit realized amounted to £2135; and after allowing for interest on debentures and the interim dividend paid in April last, the sum available for dividend, including the balance brought forward, was £1847. The Directors recommended the payment of the statutory dividends of 10, 5, and 7 per cent. on the different classes of shares. This would absorb £883, and leave £964 to be carried to the next account. A reduction of 3d. per 1000 cubic feet was made in the price of gas as from the 31st of March last, entailing a reduction in income of about £300 a year, unless, as the Directors hoped, the amount was made up by increased consumption, as might be fairly expected from the fact that 76 prepayment meters and 80 cooking-stoves had been fixed and supplied during the year. The capital of the Company has been increased by the issue of debentures to the amount of £1000, at 3½ per cent., to meet the outlay necessary for the enlargement of mains, and to keep pace with the requirements of the consumers.

**The Rainfall in August.**—According to the report presented to the Official Water Examiner for the Metropolis (Major-General A. de Courcy Scott, R.E.), by Sir W. Crookes and Professor Dewar, on the results of their examination of the water supplied to London in August, the rainfall at Oxford during that month was 1·64 inches, whereas the average for the last thirty years is 2·32 inches; leaving a deficiency of 0·68 inch. The total deficiency for the year is now 6·17 inches, or 38 per cent.

**St. Helens Corporation and the Water Supply of Rainford.**—The Rainford District Council have for some time been discussing various schemes for obtaining a water supply for the area under their jurisdiction. Up to the present, the only supply possessed by the inhabitants is that drawn from wells. The Council have now decided to accept a supply of water from the Eccleston Hill pumping-station of the St. Helens Corporation; and Lord Derby has consented to lease a ¼ acre of land for a reservoir. To carry out the necessary works, the Council will ask the Local Government Board for permission to borrow £6000.

**The Water and Gas Supply of Shipley.**—Shipley has petitioned the Privy Council for a Charter of Incorporation; and the usual protracted inquiry into the matter was held last week by Mr. C. N. Creswell. Our only immediate interest in the proceedings was in the speech of Counsel for the applicants (Mr. E. Tindal Atkinson, Q.C.), who showed the very favourable position of the water undertaking, and made a candid remark or two concerning the gas supply. He said the water supply was both abundant and independent; and during this dry season it was significant that there had not been the slightest dearth of water in the district. The supply was derived from a gathering-ground on Rumbald's Moor, a mile or two to the north-west of the town; and the elevation of the reservoirs was such that the highest point in the district was capable of being readily served by the existing supply. The highest house in the district was 750 feet; and the bottom of the supply reservoir was at an altitude of 800 feet. There were four reservoirs—one compensation, one storage, and two service. The total capacity was 110,200,000 gallons; this being independent of the Eldwick compensation reservoir, with its additional capacity of 25 million gallons. With proper economy, the present supply of water would be sufficient, without any further addition, for a population of 66,000. There was also an efficient gas supply in the town. This, however, was in the hands of a private Company, who were generous in allowing a discount of 7d. per 1000 cubic feet for prompt payment; making the price 2s. 9d. Preliminary steps had also been taken by the District Council to acquire electric lighting powers. The question the Commissioner has really to decide is whether it will be to the best interest of Shipley to receive a Charter of Incorporation or be annexed to Bradford. If the verdict is in favour of the former, then a modification of the Bradford proposals regarding the purchase of the gas-works in outlying districts will follow as a matter of course.

Messrs. G. Pettigrew and Co., of Middlesbrough, have received orders to erect their sulphate of ammonia plant at the Newmarket Gas-Works; also at Milton-next-Sittingbourne, and at the works of the Walker and Wallsend Gas Company at Willington Quay.

By an announcement which appears in another part of the "JOURNAL," it will be seen that Mr. Alfred Richards has received instructions from the Directors of the Alliance and Dublin Consumers' Gas Company to offer for sale by auction, on the 18th prox., £22,900 of 4 per cent. perpetual debenture stock of the Company.

**NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.**

**Orders for Alterations in, or Stoppages of, PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.**


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[For Illustrated Advertisement, see Sept. 6, p. 553.]

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JOSEPH TAYLOR & CO., Chemical Plumbers, &c., and Makers of every description of Solid Plate Lead and Timber Cased Saturators, &c., CENTRAL PLUMBING WORKS, TOWN HALL SQUARE, BOLTON. Special attention to Repairs.
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Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.
READ HOLLIDAY AND SONS, LIMITED, HUDDERSFIELD

TO GAS AND WATER OFFICIALS.

SPECIALLY favourable terms for Cycles. First-Class Workmanship and Material guaranteed. Art Catalogue post free.
MELROSE CYCLE COMPANY, COVENTRY.

IMPORTANT.

REPAIR your old Retorts with Patent STICKFAST FIRE CEMENT. Unequalled for Repairing Inclines. Estimates for all kinds of Retort-Settings.
Write CROWTHER, Retort Setter, and Sole Maker of Stickfast Fire Cement, Manor Street, HUDDERSFIELD.

SPECIAL PAINT FOR GAS-WORKS.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.
Telegrams: "ENAMEL." National Telephone 1769.

CANNEL, COAL, ETC.

JOHN ROMANS & SON, EDINBURGH,
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, / NEWTON GRANGE, NEWBATTLE, DALKEITH, } SCOTLAND.

PATENTS FOR INVENTIONS.

J. C. CHAPMAN, M.I.M.E., and Fel. Chartered Inst. Patent Agents. ADVICE ON ALL MATTERS CONNECTED WITH ABOVE.
Information and Handbook on application.
70, CHANCERY LANE, LONDON, W.C.

A GAS-FITTER is desirous of obtaining a Situation in the Automatic House-Fitting Department. Willing to assist in General Fittings. Good Testimonials.
Address YATES, Whitehall Street, AYLESBURY.

THOROUGHLY qualified and experienced ENGINEER and MANAGER desires similar appointment, with or without Secretarial duties. Highest references. Satisfactory reasons for changing.
Address No. 3114, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Situation as Working MANAGER in a small Gas-Works. Twenty years' Experience in the Manufacture and Distribution of Coal Gas from the Retort to the Burner, including Index Taking and Mechanical Repairs. Good References.
Apply, by letter, to No. 3136, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a Youth of about 18 years of age as a CLERK, by the Chigwell, Loughton, and Woodford Gas Company, Woodford. He must be quick and correct in Accounts, and a good Writer. Salary £1 per week.
Apply, by letter only, to the SECRETARY, at the Works.

WANTED, at once, a steady reliable Man as STOKER. Used to Shovel Charging, and understand Engine and Exhauster. Permanent Situation. Wages 28s. per week.
Apply to the MANAGER, Gas-Works, BEXHILL-ON-SEA.

WANTED by the Bexhill Water and Gas Company, a steady and competent young Man as METER INSPECTOR and COLLECTOR. Permanent Situation. Wages to commence, 25s. per week.
Apply, with References, to Mr. F. RUSSELL, Gas Office, BEXHILL-ON-SEA.

WANTED, a Stoker (Regenerative Furnaces). Wages, 31s. 6d.
Apply, with References, to the MANAGER, Gas-Works, CARNARVON.

SUB-MANAGER.

WANTED, shortly, for a Gas-Works in Ireland, a thoroughly competent and reliable Man as SUB-MANAGER, who will be required to take entire responsibility in the Manager's absence.
He must be well up in Carbonizing and Distributing Departments, and have had some Mechanical experience. He will be required to reside on the Premises. House, Coal, and Gas free.
Apply, by letter, stating Age, Practical Knowledge, and Salary required, with *copies* of two recent Testimonials, to No. 3132, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

MERTHYR TYDFIL GAS COMPANY.

WANTED, a competent young Man as INSPECTOR OF METERS and ASSISTANT CLERK in the Gas-Fittings Department. Wages, 25s. per week.
Applications, in own handwriting, stating Age, where last employed, and enclosing *copies* only of three recent Testimonials as to Character, &c., to be addressed to the undersigned not later than Wednesday, the 5th of October prox.
JOHN L. COCKER,
Secretary and General Manager.
Gas Office and Works, Merthyr Tydfil,
Glamorganshire, Sept. 10, 1898.

SECRETARY WANTED.

THE Directors of the Sheppy Gas Company are desirous of receiving APPLICATIONS from duly qualified persons, to undertake the duties of SECRETARY in December next. The Salary will be £200 per annum, without Residence. The applicant must be between 30 and 40 years of age, and have a good knowledge of up-to-date Gas Business, including Prepayment Meters, Stoves, Ranges, and General Fittings, on sale or hire, as well as regular Secretarial Work. He will have the assistance of a thoroughly good Assistant and Collector, who resides at the Office. One previously engaged under a Provincial Company will be preferred.
Applications in own writing to be addressed to the Chairman, Gas Office, 2, Trinity Road, Sheerness-on-Sea, endorsed "Secretaryship," and be delivered not later than the first morning delivery on Wednesday, the 12th of October next.
By order,
A. W. MARKS,
Secretary.
Gas Company's Office, Sheerness-on-Sea,
Sept. 14, 1898.

BOROUGH OF PLYMOUTH.

THE Corporation are prepared to receive APPLICATIONS from suitable persons for the position of FOREMAN, who will be required to take charge of the Street Gas Lighting of the Borough under the direction of the Borough Engineer.
The person appointed must be competent to Test all Burners and Governors and the Illuminating Power of the Gas by means of the Photometer.
Applicants, in applying, must state their Age and full Particulars of past Experience and present Employment.
Applications, accompanied by *copies* of not more than three recent Testimonials, to be forwarded to me not later than the 1st of October, endorsed "Foreman."
Canvassing Members of the Council either directly or indirectly will be deemed a disqualification.
The Salary will be £2 5s. a week.
JAMES PATON,
Borough Engineer and Surveyor.
Municipal Offices, Plymouth,
Sept. 20, 1898.

WANTED, Carbon in 4 Ton Lots, or more; also OIL CARBON.
State Price, f.o.r. at nearest Station, to No. 3031, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WORKING Foreman wanted for Gas-Works, making 40 millions, near London. Able and willing to undertake any manual employment on Works or in District. Must be a good Blacksmith. Wages 36s. per week.
Apply, with Testimonials, to No. 3137, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

GASHOLDER for Sale, 100 ft. diameter by 20 ft. deep, in good working condition. Can be seen working up to the middle of October at the Gas-Works, Ramsgate.
CLAYTON, SON, & Co., LTD., Gas Engineers, Hunslet, LEEDS.

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. **Compare Prices and Particulars before ordering elsewhere.**
J. F. BLAKELEY, Gas Engineer, Ravensthorpe, YORKS.

FOR SALE—One Station Meter (3-inch Inlet and Outlet, connection to Bye-Pass 4 inch), in good working order; one HYDRAULIC MAIN, U, 18-inch, 6 ft. 9 in. long; five ARCH-PIPES and DIPS, 4-inch; four MOUTHPIECES, 15-inch, round, with LIDS.
Address F. M. MAULDON, Secretary, Gas Company, MANNINGTREE.

GAS-WORKS, GRINGLEY-ON-THE-HILL.

TO BE SOLD, Privately—A small COUNTRY GAS-WORKS in good Condition—comprising Machinery, Mains, Services, Meters, &c. Also two newly-built COTTAGES and Gardens on the Site, and sufficient Ground for large Coal-Yard, or two more Cottages. This is a first-rate opening for a Smith or Plumber.
For Particulars apply to H. & F. BAILEY, Gas Engineers, EAST RETFORD.

GREAT GRIMSBY GAS COMPANY.

SURPLUS TAR.

THE Directors of the above Company are open to receive TENDERS for the purchase of their surplus TAR, delivered on Rail in Purchaser's Tanks, for One Year ending 30th of September, 1899.
Sealed Tenders to be sent to the undersigned on or before Monday, the 3rd of October next.
JAS. BROADHEAD, Manager.
Gas-Works, Great Grimsby,
Sept. 25, 1898.

RAMSGATE CORPORATION,
(GAS AND WATER DEPARTMENT.)

THE following required:
250 12-feet lengths of 12-inch GAS-PIPES.
10 Tons ORDINARY SPECIALS, various diameters
Tenders to be sent in not later than Sept. 30, addressed to the Chairman of the Gas and Water Committee, Hardres Street, Ramsgate.
The Committee do not bind themselves to accept the lowest or any Tender.
Full Particulars on application to William A. Valon, Engineer.
W. A. HUBBARD, Town Clerk.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TO TAR DISTILLERS.

THE Directors of this Company invite TENDERS for the purchase of 720 Tons of the surplus TAR to be produced at their Works in Radcliffe during the Twelve Months commencing the 1st day of November next.
Particulars may be obtained from the undersigned, to whom endorsed Tenders must be delivered not later than Tuesday, the 4th of October.
JAS. BRADDOCK,
Manager and Secretary.
Gas-Works, Radcliffe,
Sept. 24, 1898.

GWYNNE & BEALE'S
PATENT
GAS-EXHAUSTERS AND STEAM-ENGINES
FOR FULL PARTICULARS, APPLY TO THE MAKERS:
GWYNNE & CO.,
Telegrams: "GWYNNEGRAM, LONDON."
HYDRAULIC AND GAS ENGINEERS
(Late Essex Street Works, Victoria Embankment, London),
Telephone No. 95 Holborn.
BROOKE STREET WORKS, HOLBORN, LONDON, E.C.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held MONTHLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by Auction of Gas and Water Stocks and Shares under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. Alfred Richards's Offices, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
ALLIANCE AND DUBLIN CONSUMERS' GAS COMPANY,

£22,900 FOUR PER CENT.
PERPETUAL DEBENTURE STOCK,
Offering to Trustees and others an Investment of the highest class.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, Tokenhouse Yard, London, E.C., on Tuesday, Oct. 18, 1898, at Two o'clock precisely, in Lots.

Particulars at the HEAD OFFICES OF THE COMPANY, in D'Olier Street, DUBLIN; and of the AUCTIONEER, 18, Finsbury Circus, LONDON, E.C.

By order of the Directors of the
PLYMOUTH AND STONEHOUSE GASLIGHT AND COKE COMPANY.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, E.C., on Tuesday, Oct. 18, at Two o'clock, in Lots,
£10,000 OF ORDINARY STOCK
OF THE
PLYMOUTH AND STONEHOUSE GASLIGHT AND COKE COMPANY,
Ranking for a Standard Dividend of 5 per cent., subject to the Sliding-Scale; the last Dividend on similar Stock in the Company having been at the rate of 6⅛ per cent.

Particulars may be obtained at the COMPANY'S OFFICES, 1, Athenæum Terrace, PLYMOUTH; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Directors of the
SOUTHEND WATER-WORKS COMPANY.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, E.C., on Tuesday, Oct. 18, at Two o'clock, in Lots,
500 £10 SHARES
(issued as fully paid) in the above Undertaking, ranking for a Maximum Dividend of 7 per cent.; the last Dividend on similar Shares having been 5½ per cent.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

By order of the Executors of the late G. E. Wood, Esq.
339 £10 SHARES IN THE
HAMPTON COURT GAS COMPANY
AND THE
WALTON-ON-THAMES AND WEYBRIDGE GAS COMPANY.

MR. ALFRED RICHARDS will Sell THE ABOVE BY AUCTION, at the Mart, E.C., on Tuesday, Oct. 18, at Two o'clock precisely, in Lots.

Particulars of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

*Now Ready, Crown 4to., Price 3s. 6d.*

GASHOLDER AND TANK

(Of One Million Cubic Feet Capacity)
AT THE
*SUTTON GAS-WORKS.*
Designed and carried out by
F. SOUTHWELL CRIPPS, Assoc.M.Inst.C.E.,
MEMBER OF THE INSTITUTION OF GAS ENGINEERS,
MEMBER OF THE SOCIETY OF ARTS,
CONSULTING ENGINEER.

EMBRACING NOTES ON GASHOLDER CONSTRUCTION GENERALLY.

REPRINT OF A SERIES OF ARTICLES IN THE "JOURNAL OF GAS LIGHTING," &c., WITH THE ACCOMPANYING PLATES.

*Other Works by the same Author.*

The Guide-Framing of Gasholders, and Strains on other Structures in Gas-Works 6s. 0d.
Gasholders With or Without Guide-Framing: A Discussion; and Literature on Gasholder Construction . . . . 1s. 0d.
Flow of Gas, and Proportioning Gas-Mains 7s. 6d.

PUBLISHED BY
WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD
BLACK BED GAS COAL.

*Prices and Analysis on application.*

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

NOW READY.

*Foolscap 4to, pp. 535, with 239 Illustrations and Steel Plate Engraving (as Frontispiece) of* WILLIAM MURDOCH, *Inventor of Gas Lighting.*
*Morocco Gilt, 21s.; Roan Gilt, 18s.*

THE SIXTH (AND CENTENARY) EDITION
OF THE

HANDBOOK
FOR
GAS ENGINEERS
AND MANAGERS.
BY
THOMAS NEWBIGGING,
M.Inst.C.E.

**This Edition of the "Handbook for Gas Engineers and Managers" is a great improvement on all previous editions. Much of the text has been re-written, in order to keep the work abreast of the constant advances that are being made in the Gas Industry. About fifty additional Illustrations are given; and a Steel-Plate Engraving of William Murdoch, the Inventor of Gas Lighting.**

*PRINCIPAL CONTENTS.*

Introduction; Chief Kinds of Coal; Analyses of Coals and Cannels; Storage of Coal; Spontaneous Ignition of Coal; Gases Occluded in Coal; Testing of Coal for its Producing Qualities; Gas Production; Retort-House; Inclined or Sloping Retorts; Retort-Stack; Retorts; Retort-Settings; Regenerative System of Heating Retorts; Flues and Draught; Analysis of Furnace Gases; Retort-Bench Mountings; Hydrocarbon and other Gases and Vapours; Retort-House Tools and Appliances; Machine Charging and Drawing; Condensation; Naphthalene; Condensers; Exhausters; Steam Engines and Boilers; Washers; Tower Scrubbers; Washer-Scrubbers; Bye-Pass Mains and Valves; Tar and Liquor Wells and Tanks; Purification; Purifying-House; Purifiers; Limestones and Lime Burning; Station Meter and other Indicating and Recording Apparatus; Gasholder Tanks; Gasholders; Governors; Main-Pipes; Main-Pipe Joints; Wrought-Iron and Steel Main-Pipes; Laying of Main-Pipes; Discharge of Gas through Main-Pipes; Service-Pipes and Fittings; Public Lighting; Consumers' Gas-Meters; Testing-Meters; Internal Fittings; Gas Testing Appliances and Methods; Tests for Impurities; Illuminating Power; The Aerorthometer; Foreign and other (proposed) Home Standards of Light; Jet Photometers; Specific Gravity of Gas; Enrichment of Coal Gas; Public Illuminations; Coloured Fires; Illumination Devices; Use of Gas for Purposes other than Lighting; Residual Products; Coal Tar; Ammoniacal Liquor; Sulphur Recovery; Coal Products; Elementary Substances; Chemical and other Memoranda; The Gas Industry; Cost of Gas-Works; Miscellaneous; Bricks and Brickwork; Mortar and Concrete; Iron, Steel, and other Metals; Velocity and Force of the Wind; Office Memoranda; Epitome of Mensuration; Arithmetical and Algebraical Signs; Multipliers; Table of Diameters, Circumferences, Areas of Circles and Sides of Equal Squares; Weights and Measures; French Weights and Measures—Decimal System; Money Tables.

LONDON:
WALTER KING, 11, BOLT COURT,
FLEET STREET, E.C.


LEIGH URBAN DISTRICT COUNCIL.
(GAS DEPARTMENT.)

THE Gas Committee of the above Council are prepared to receive TENDERS for the carrying out of various Works in connection with the alterations of a Bench of Inclined Retorts.

Plans and Copies of Specification, with Terms and Conditions of Tender, may be obtained at the Office of the Engineer, Mr. John Foster, Gas-Works, Leigh, Lancashire, on and after Thursday, the 29th of September, 1898, on payment of Three Guineas, which sum will be returned on receipt of a *bonâ fide* Tender.

Sealed Tenders, endorsed "Tender for Inclined Retorts," must be addressed to me at the Town Hall, Leigh, and delivered on or before Twelve o'clock noon on Friday, the 14th day of October, 1898.

The Committee do not bind themselves to accept the lowest or any Tender.

By order,
PEREGRINE THOMAS,
Clerk and Solicitor.

Town Hall, Leigh, Lancs.,
Sept. 22, 1898.

COMMERCIAL GAS COMPANY.

THE Directors of the Commercial Gas Company are prepared to receive TENDERS for the surplus BREEZE produced at their several Works for the Twelve Months ending the 30th of Sept., 1899.

The quantities are estimated to be as under, but the same cannot be guaranteed, and may be more or less:

At the Stepney Works on the Regent's Canal—
1500 chaldrons (of 48 bushels) of Fine Coke Breeze, and
1500 chaldrons (of 48 bushels) of Rough Pan Breeze.

At the Wapping Works, on the River Thames—
2000 chaldrons (of 48 bushels) of Fine Coke Breeze, and
2000 chaldrons (of 48 bushels) of Rough Pan Breeze.

At the Poplar Works, in Bow Creek (free waterway)—
4000 chaldrons (of 48 bushels) of Fine Coke Breeze, and
4000 chaldrons (of 48 bushels) of Rough Pan Breeze.

The Tenders may be for the whole or for one or more Works separately.

The Contractors must give security to remove the Breeze as it accumulates, to pay for the same monthly, and generally for the due fulfilment of the Contract.

The Form of Agreement to be signed can be seen at the Company's Offices.

Tenders, sealed and endorsed "Tender for Breeze," to be delivered here not later than the 6th of October prox.

The Directors reserve to themselves the right to accept any Tender in part or in whole, and do not bind themselves to accept the highest or any Tender.

Commercial Gas-Works, Stepney, E.,
Sept. 16, 1898.

KING'S LYNN GAS COMPANY.

Issue of £1000 PREFERENCE FOUR PER CENT. STOCK, under the King's Lynn Gas Order, 1888, confirmed by the Gas Orders Confirmation (No. 2) Act, 1888, and £6400 PREFERENCE FOUR PER CENT. STOCK, under the King's Lynn Gas Order, 1898, confirmed by the Gas Orders Confirmation (No. 1) Act, 1898.

NOTICE is Hereby Given, that, on the 8th of October, 1898, the Directors will receive TENDERS for the purchase of the ABOVE STOCK in 74 Lots of £100 each.

Printed Conditions and Forms of Tender may be had on application, by post or otherwise, to the Manager, Gas-Works, King's Lynn, or to the undersigned.

By order,
J. J. COULTON
F. H. PARTRIDGE } Clerks.

King's Lynn, Sept. 6, 1898.

THE Acetylene Illuminating Company, Limited, 63, Queen Victoria Street, London, E.C., GIVE NOTICE that they hold the BRITISH PATENT RIGHTS for the MANUFACTURE OF CALCIUM CARBIDE by means of the electric furnace, that they are bringing an action against the Midland Acetylene (Parent) Syndicate, Limited, to restrain them from so manufacturing that product, and that they intend in the future to bring actions against all infringers of these Patents and all purchasers or users of Carbide of Calcium made in infringement of the same.


JAMES OAKES & CO.
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.,
Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with Bolts, Nuts and Covers, and rendering Leakage impossible.

## HEATHCOTE GAS COAL.

Rich in Illuminating Power and Yield of Gas.
Above the Average in Weight and Quality of Coke.
Maintains a High Standard in Residuals.

## THE GRASSMOOR CO., LD.

CHESTERFIELD.

## BOLDON GAS COALS.

ANALYSIS.

| | | |
|---|---|---|
| Yield of Gas per ton . | 10,500 | Cubic Feet. |
| Illuminating Power . . | 16·9 | Candles. |
| Coke . . . . . | 66·7 | Coke. |
| Sulphur . . . . . | 0·86 | Sulphur. |
| Ash . . . . . | 3·04 | Ash. |

For Prices, &c., apply to

W. H. PARKINSON,
THE HARTON COAL CO., LTD.,
NEWCASTLE-ON-TYNE.

Telegraphic Address: "PARKINSON NEWCASTLE."

## THOMAS TURTON AND SONS, LIMITED,

SHEAF WORKS, SHEFFIELD,
*MANUFACTURERS OF*
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.

SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.

LONDON OFFICE:
90, CANNON STREET, E.C.

## HOLMSIDE GAS COALS.

Present Daily Produce over 5000 Tons.

*Latest Analysis—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation*

| | |
|---|---|
| Yield of Gas per Ton . . . | 11,205 Cubic Feet. |
| Illuminating Power | 16 7/10 Stand. Sperm. Candl. |
| Coke (of good & pure quality) | 13¾ Cwt. per Ton. |
| Sulphur . . . . . | A little over 1 per Cent. |
| Ash . . . . . | Under 1 per Cent. |
| Tar . . . . . | 163 lbs. (Avoir.) per Ton. |
| Ammoniacal Liquor | 103 lbs. (Avoir.) per Ton. |

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR
PELTON GAS COALS.

Present Daily Produce available 3000 Tons.

Of equal quality to the "Holmside" Coal, and also very largely used by many Gas Companies at Home and Abroad.

Both descriptions are shipped at Tyne Docks, and Dunston Staiths, River Tyne, also at North and South Docks, Sunderland.

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE & SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

## LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,

COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO

S. J. DITCHFIELD,
SEAHAM HARBOUR, COUNTY OF DURHAM.

GAS PURIFICATION BY
HYDRATED OXIDE.

THIS Material is of full Strength, and Exceptional Activity. It is specially prepared to minimize Back-Pressure; and will be supplied on Hire, or Sold, on the most favourable Terms.

SPENT OXIDES containing Blue, also CRUDE FERRO-CYANIDE PRODUCTS, either PURCHASED or EXCHANGED for FRESH OXIDE.

MANCHESTER OXIDE COMPANY, LTD.,
CANAL ST., MILES PLATTING, MANCHESTER.

## THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON & COAL CO., LD.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by
Messrs. J. & H. S. PATTINSON, *May 28, 1895*.

| | |
|---|---|
| Yield of Gas per Ton . . | 10,500 Cub. Ft. |
| Illuminating Power . . | 16·9 Candles. |
| Coke (of good quality) . | 67·5 per Cent. |
| Sulphur . . . . . | 0·58 „ |
| Ash . . . . . | 2·78 „ |

For Price, &c., apply to the

WEARDALE IRON & COAL CO., LD.
QUAYSIDE, NEWCASTLE-ON-TYNE.

## INCANDESCENT GAS LIGHTING

Has now gained a complete and final Victory over its last and greatest Enemy

VIBRATION,

BY MEANS OF

CLAY'S PATENT
SHOCK-PROOF
Incandescent Burner Fittings

Of which full Particulars may be had from

CLAY & WALMSLEY,
BOLTON, ENGLAND.

Telegrams: "CLAYS, BOLTON."

See "JOURNAL OF GAS LIGHTING,"
July 7, 1896, p. 19, and Dec. 21, 1897, p. 1365.

London Representatives: H. Greene & Sons, Ltd., 153 & 155, Cannon Street, E.C.

## AUTOMATIC METER REGISTER

The Meter Life Book specially adapted, and revised for "Slot" Meter Registration by

ROBERT P. KEYS.

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|---|---|
| In sizes to record 1000 Meters, with Index, Half Bound .. .. | £2 2 0 |
| To record 500 Meters .. .. | £1 15 0 |
| To record 250 Meters .. .. | £1 11 6 |

The only Easy System yet projected.

PUBLISHED BY
WALTER KING, 11, Bolt Court, Fleet Street, E.C.

## HEBBURN MAIN GAS COALS.

| | |
|---|---|
| Yield of Gas per ton . . . . . | 10,500 cub. ft. |
| Illuminating Power . . . . . | 16·4 candles. |
| Coke . . . . . | 68 per cent. |

For Prices, f.o.b. Ship or Delivered by Rail, apply to

THE WALLSEND & HEBBURN COAL COMPANY, LTD.
8 Lombard Street,
NEWCASTLE-ON-TYNE.
W. RICHARDSON, Fitter.

## WELDON MUD FOR GAS PURIFICATION,

For use in the

RECOVERY OF SULPHUR,
ALSO
Removal of last Traces of SULPHURETTED HYDROGEN in catch position.

Full Particulars on application to the Patentees:

GAS DESULPHURIZATION CO.,
— *LIMITED*, —
1, FENCHURCH AVENUE, LONDON, E.C.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

## CANNEL & COAL.

TYNE
BOGHEAD CANNEL.

| | |
|---|---|
| Yield of Gas per ton . . . . . | 13,155 cub. ft. |
| Illuminating Power . . . . . | 38·22 candles |
| Coke per ton . . . . . | 1,301·38 lbs. |

## EAST PONTOP GAS COAL.

| | |
|---|---|
| Yield of Gas per ton . . . . . | 10,500 cub. ft. |
| Illuminating Power . . . . . | 17·8 candles. |
| Coke . . . . . | 70 per cent. |

## SOUTH PELAW MAIN GAS COAL.

| | |
|---|---|
| Yield of Gas per ton . . . . . | 10,500 cub. ft. |
| Illuminating Power . . . . . | 16·3 candles. |
| Coke . . . . . | 73·1 per cent. |

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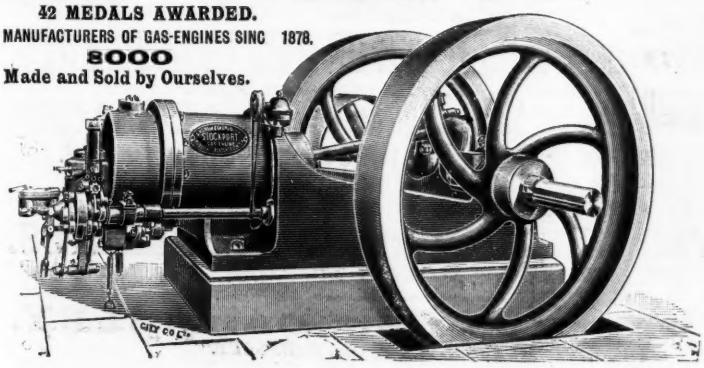

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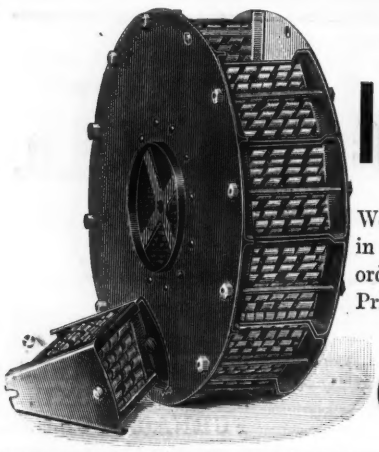

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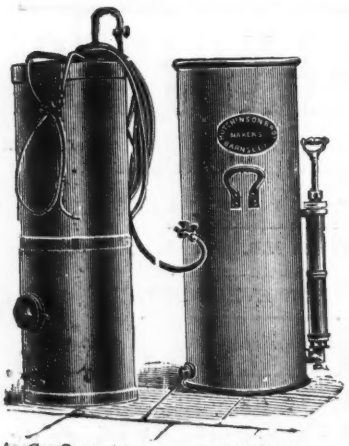

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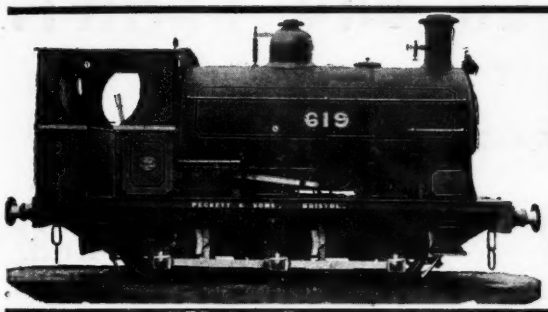


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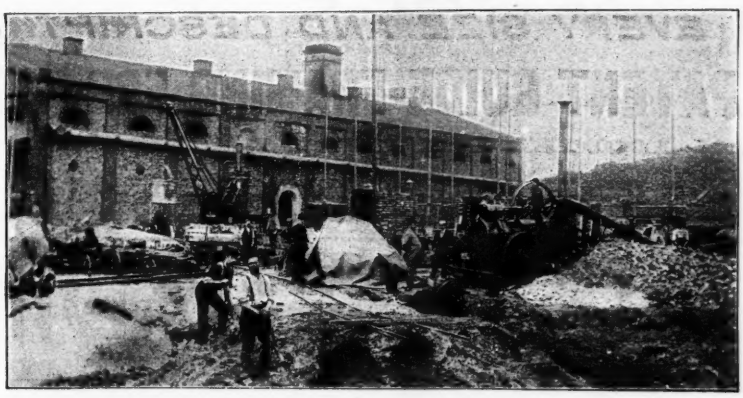

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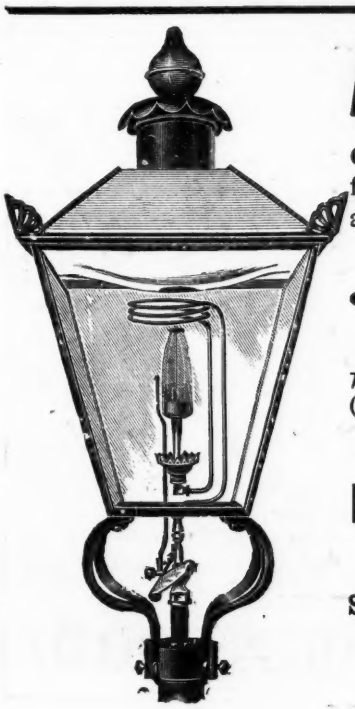

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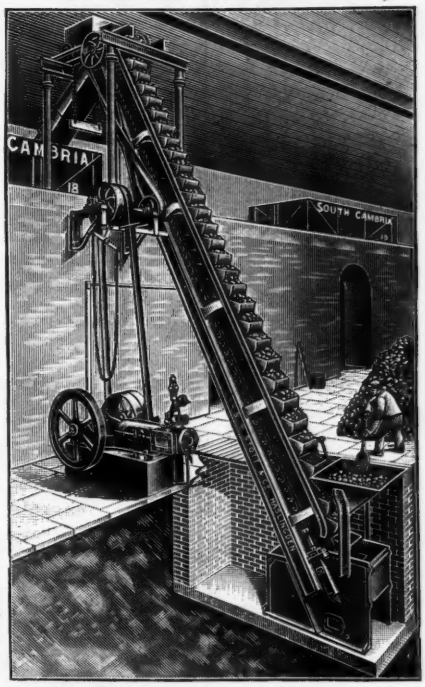


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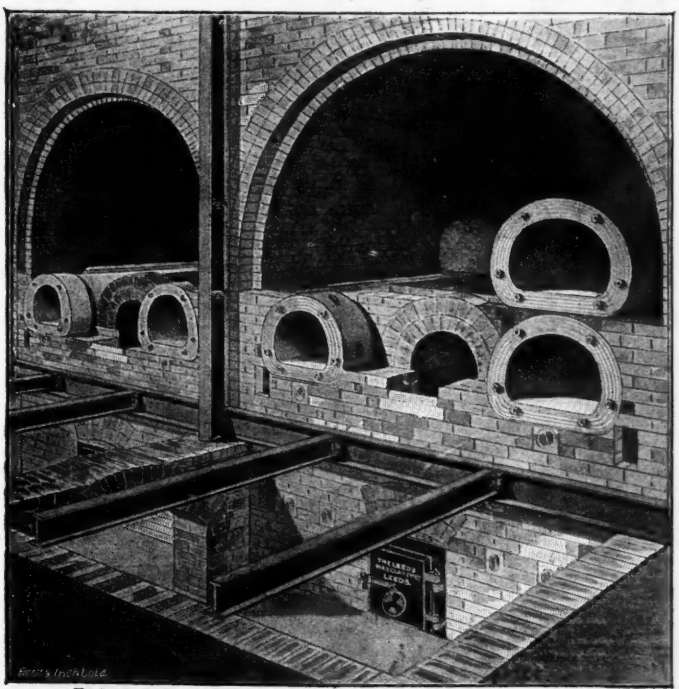

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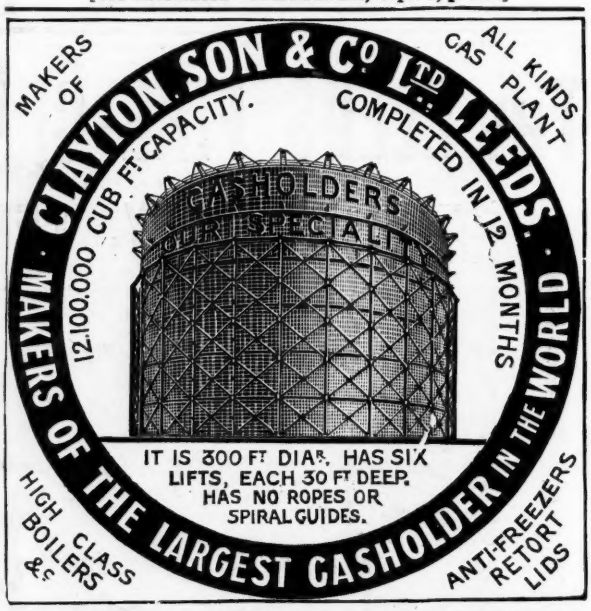
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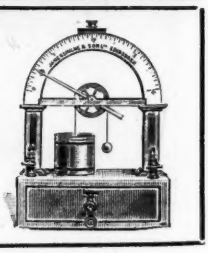

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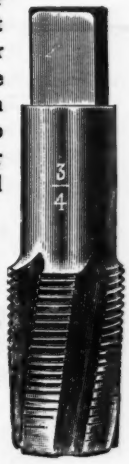


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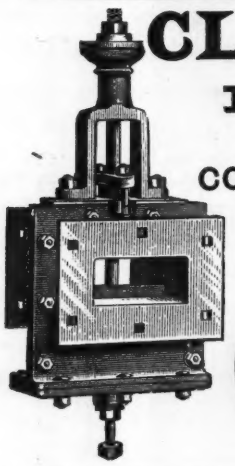

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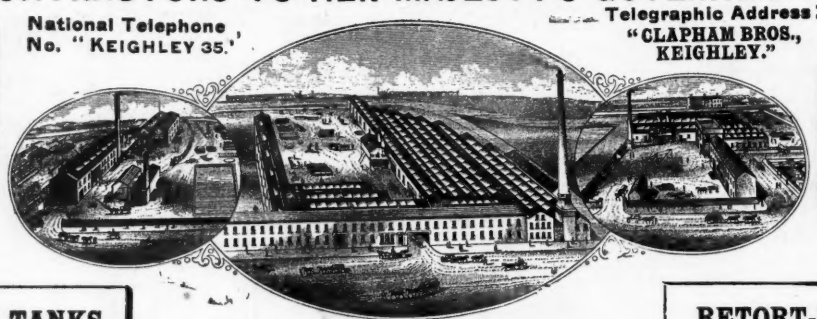

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LONDON: Printed by WALTER KING (at the Office of King, Sell, and Railton, Ltd., 12, Gough Square); and published by him at 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, Sept. 27, 1898.